ABSTRACTS

OF

THE PAPERS

PRINTED IN THE

PHILOSOPHICAL TRANSACTIONS

OF THE

ROYAL SOCIETY OF LONDON,

From 1837 *to* 1843 *inclusive.*

VOL. IV.

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CONTENTS.

VOL. IV.

1837.

1838.

CONTENTS.

VOL. IV.

1837.

1838.

1839.

1840.

1841.

1842.

1843.

ERRATUM.

P. 386, line 9, *for* "the filaments of which are," *read* "this filament is."

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1837. No. 30.

November 16, 1837.

FRANCIS BAILY, Esq., V.P. and Treasurer, in the Chair,

"Description of a new Barometer, recently fixed up in the Apartments of the Royal Society; with remarks on the mode hitherto pursued at various periods, and an account of that which is now adopted, for correcting the observed height of the mercury in the Society's Barometers." By Francis Baily, Esq., Vice-President and Treasurer, R.S.

The barometer, here alluded to, may in some measure be considered as two separate and independent barometers, inasmuch as it is formed of two distinct tubes dipping into one and the same cistern of mercury. One of these tubes is made of *flint* glass, and the other of *crown* glass, with a view to ascertain whether, at the end of any given period, the one may have had any greater chemical effect on the mercury than the other, and thus affected the results. A brass rod, to which the scale is attached, passes through the framework, between the two tubes, and is thus common to both: one end of which is furnished with a fine agate point, which, by means of a rack and pinion moving the whole rod, may be brought just to touch the surface of the mercury in the cistern, the slightest contact with which is immediately discernible; and the other end of which bears the usual scale of inches, tenths, &c.; and there is a separate vernier for each tube. A small thermometer, the bulb of which dips into the mercury in the cistern, is inserted at the bottom: and an eyepiece is also there fixed, so that the agate point can be viewed with more distinctness and accuracy. The whole instrument is made to turn round in azimuth, in order to verify the perpendicularity of the tubes and the scale.

It is evident that there are many advantages attending this mode of construction, which are not to be found in the barometers as usually formed for general use in this country. The absolute heights are more correctly and more satisfactorily determined; and the permanency of true action is more effectually noticed and secured. For, every part is under the inspection and control of the observer; and any derangement or imperfection in either of the tubes is immediately detected on comparison with the other. And, considering the care that has been taken in filling the tubes, and setting off the

scale, it may justly be considered as a *standard barometer*. The present volume of the *Philosophical Transactions* will contain the first register of the observations that have been made with this instrument.

Mr. Baily then enters into a description of the several corrections that are required for the various kinds of barometers, in order to make them comparable with one another; and treats of each of these in their order. First as to the correction for temperature, both of the mercury and of the scale; next for capillarity; and afterwards for the height of the barometer above the level of the sea. A table is given for the first of these corrections; and a convenient formula for the latter: the correction for capillarity is constant, and of very small magnitude.

The author next describes the mode in which the observations of the barometer have, from time to time, been recorded in the Meteorological Journal of this Society; and points out several inaccuracies which have occasionally been committed in this department, for want of an uniform plan of reduction. Now this state of confusion and uncertainty he remarks ought not to exist in a meteorological journal emanating from this Society, more especially as the true values are as easily attainable as the approximate ones. And although, in a general point of view, the minute differences caused by such errors may be unimportant, yet as appeals are frequently made to the barometer of this Society, as a standard, by persons engaged in important researches, the most scrupulous accuracy ought to be adopted and pursued, and the fullest explanation placed on record. And Mr. Baily says that notwithstanding the details which he has given may create some doubt respecting the accuracy of the past, yet he is persuaded that the system now pursued will inspire more confidence for the future. It is on this account that he has entered thus at large on the subject; trusting that what he has stated will not only tend to preserve for the future a more correct and uniform system, but also justify the Council in directing that the register should henceforth contain the daily observations *uncorrected*, and thus prevent the possibility of any similar confusion and mistakes hereafter.

Mr. Baily then adverts to the height of the Society's barometer above the mean level of the sea; a subject of much interest to many persons engaged in various pursuits, but which appears, from the notes attached, at different periods, to the meteorological journal of this Society, to be involved in some confusion and uncertainty. Thus, prior to the year 1823, the cistern of the barometer is said to be 81 feet above the level of low-water spring tides at Somerset House; but without any information how this was connected with the sea. From 1823 to 1825, both inclusive, it is said to be 100 feet above the same level. And from 1826 to 1836, both inclusive, the above indication is omitted, and the height is said to be 83 feet 2½ inches above a *fixed mark* on Waterloo Bridge; or "above the mean level of the sea (presumed about) 95 feet." The discordance between the 81 feet and the 100 feet is easily accounted for by the fact that

the old barometer, prior to 1823, was fixed up in the Council-room of the Society, or the contiguous ante-room: but when Mr. Daniel's barometer was finished, at the end of the year 1822, it was fixed up in the closet adjoining the library, on the floor which is immediately *over* the Council-room; the assumed difference in the elevation of the two floors (namely, 19 feet) having since been ascertained to be correct.

With respect to the new reference of altitude, namely, the fixed *mark* at Waterloo Bridge, much doubt has frequently been expressed about its existence, since no person had been able to discover it. The fact is that there is no *mark*, in the common acceptation of the term; but the intended reference is nevertheless more conspicuous, more durable, and more convenient than any mark that could have been inscribed by hands. This standard mark, or level, was fixed on by Mr. Bevan in the year 1827, at the request of the Council of this Society: and it is the surface of the granite pedestal at the base of the columns, at the north abutment of the bridge, and on the eastern side; which is about 5 feet above the lowest platform, or landing, at the stairs. Nothing therefore was wanting but the difference of level between this mark and the one made by Capt. Lloyd at London Bridge, the height of which above the mean level of the sea had been determined by him. This has been recently done by Sir John Rennie, at the request also of the Council: and the result of the whole is, that the cistern of the barometer is 97 feet above the mean level of the sea.

The author concludes his paper with some remarks on the propriety of the position of the several meteorological instruments of the Society. With respect to the *barometer*, he says he is not aware that any objection can be offered; and as to the *hygrometer*, the observations have been found, by recent trials, not to differ materially from some expressly made in another position, at King's College, which was considered to be more favourable for such experiments. It therefore only remains to speak of the external *thermometer* and of the *rain-gauge*; of which all that can be said on the subject would be merely a repetition of what was justly said sixty years ago by Mr. Cavendish on a similar occasion (Philosophical Transactions, 1776), namely, "that, on the whole, the situation is not altogether such as could be wished, but is the *best* the house affords."

November 23, 1837.

FRANCIS BAILY, Esq., V.P. and Treasurer, in the Chair.

The following gentlemen were, by ballot, elected Auditors of the Treasurer's accounts, on the part of the Society, viz. John Frederick Daniell, Esq.; Sir Philip Grey Egerton, Bart.; Davies Gilbert, Esq.; and Stephen Peter Rigaud, Esq.

Frederick William Mullins, Esq., was balloted for, but not elected into the Society.

"Magnetical Observations made in the West Indies, on the Coasts

of Brazil and North America, in the years 1834, 1835, 1836 and 1837." By Sir James Everard Home, Bart., Commander Royal Navy, F.R.S., the Observations reduced by the Rev. George Fisher, M.A., F.R.S.

The observations for the dip were made with an instrument of modern construction, by Dollond. Each observation consisted of an equal number of readings of the position of the needle, before and after the inversion of its poles, and a mean of all the readings taken for the true dip. Tables are subjoined, containing the dips observed at each place; the times of making a hundred vibrations of five horizontal needles, and the mean horizontal forces computed therefrom; and likewise the results estimated in the direction of the dipping needle, compared with direct experiments made with the dipping needle itself.

A paper was also read in part, entitled "On Low Fogs and Stationary Clouds." By William Kelly, M.D. Communicated by Capt. Beaufort, R.N., F.R.S.

November 30, 1837.

At the Anniversary Meeting of the Royal Society, Francis Baily, Esq., Vice-President and Treasurer, in the Chair,

The Chairman read a letter from His Royal Highness the President, expressing his regret that he was unable to be present at the Meeting, in consequence of his continuing to suffer from his recent accident.

Mr. Davies Gilbert, as one of the Auditors of the Treasurer's accounts on the part of the Society, reported the balance in the Treasurer's hands at the present Audit was three hundred and thirty-seven pounds three shillings and eight pence.

The Thanks of the Society were voted to the Auditors for their trouble in auditing the Treasurer's Accounts.

The following Lists of the Fellows admitted, and of those deceased during the past year, were read:

Deceased: on the Home List.—His Majesty *The King;* James Henry Arnold, Esq.; Count Barbiano Bolgioiso; the Rev. Joseph Batten; Samuel D. Broughton, Esq.; Henry Thomas Colebrooke, Esq.; Earl Cowper; John Davidson, Esq.; Alexander Duncan, Esq.; the Earl of Egremont; Cypriano Ribeiro Freire; Lord Glenlyon; Sir Thomas Hanmer, Bart.; George Hibbert, Esq.; Joseph Jekyll, Esq., M.A.; John Johnstone, M.D.; John Latham, M.D. (*Winchester*); the Marquess Malaspina de Sannazaro; Captain Z. Mudge, R.E.; the Rev. Robert Nixon, B.D.; Lewis Pinto de Souza Coutinho; the Rev. William Ritchie, LL.D.; the Rev. George Rowley, D.D.; Joseph Sabine, Esq.; Count de Salis; the Bishop of Salisbury; Sir John Soane, Knt.; Dr. Tiarks; Edward Turner, M.D.

On the Foreign List.—M. Adam Afzelius; M. Morichini.

Admitted: on the Home List.—William Ayrton, Esq.; Robert Bigsby, Esq.; Henry Boase, M.D.; John Burnet, Esq.; Benjamin

Bond Cabbell, Esq.; James Carson, M.D.; William Tierney Clark, Esq.; George Edward Frere, Esq.; Thomas Graham, Esq., M.A.; Charles Holland, M.D.; William Hopkins, Esq., M.A.; Robert Hunter, Esq.; James F. W. Johnston, Esq., M.A.; Richard Partridge, Esq.; Joseph Ellison Portlock, Esq.; John Urpath Rastrick, Esq.; John Forbes Royle, M.D.; Frederic C. Skey, Esq.; John F. Smith, Esq.; Samuel Solly, Esq.; the Rev. William Walton; J. R. Wellsted, Esq.; Richard Westmacott, Esq.; William Archibald Armstrong White, Esq.; William Page Wood, Esq.

On the Foreign List.—M. Becquerel; Prof. Ehrenberg; Admiral von Krusenstern; Chevalier Mirbel.

The following Address of His Royal Highness the President to the present Meeting, was read from the Chair by the Chairman.

GENTLEMEN,

WHEN I last had the honour of addressing you from this Chair, I ventured to express a hope that the happy restoration of my sight, and the continued possession of health, would have enabled me to discharge, with becoming regularity, the duties of President of this Society during those portions of the year in which I am generally resident in London: the fulfilment, however, of that hope was unhappily frustrated by a long and dangerous illness, which confined me for several months to my apartments and from the effects of which I have hardly yet entirely recovered. I trust, Gentlemen, you will pardon me if I look forward with brighter hopes to the prospects of another year; and if I hesitate to regard the unhappy experience of that which is past as a premonition of the fate which awaits me in those which are to come; if such were my assurance or reasonable fear, I should acquiesce in the duty and propriety of at once retiring from this Chair and of no longer soliciting the renewal of an honour which I have enjoyed for so many years; but if it should be the pleasure of that good Providence, whose chastisements and whose mercies I have so often before experienced, to disable me from presiding over this Society in such a manner as might be considered necessary for the protection and maintenance of its just interests and dignity, I should bow with humble resignation to the expression of His will, and resign into other hands the discharge of those duties for which I should feel myself no longer qualified.

Since the last Annual Session of this Society we have lost, Gentlemen, a most munificent patron and benefactor, by the demise of our late most gracious Sovereign, King William the Fourth, of whom it is difficult for me to speak in terms which do justice to my feelings. He was, indeed, not less distinguished by the exalted station which he filled, than by the warmth and sincerity of his affections as a husband, a brother, and a friend; by the undisguised frankness and truth of his character as a man; and as a monarch, by his patriotic zeal to increase the efficiency and secure the permanence of the great institutions of his country and to extend to all classes of his subjects the blessings of peace and knowledge and the protection

of just and equal laws. I would gladly enlarge, if the time or the occasion would permit me to do so, upon these and many other virtues in the character of one who was so closely connected with me by the ties of relationship and of duty; but I am quite sure that I should fail in the expression both of your sentiments and my own, if I did not acknowledge, in becoming terms of respect and gratitude, the especial patronage and protection which he extended to the Royal Society, by the renewed grant of the two Annual Medals which had been instituted by his royal brother and predecessor, and by the enactment of such statutes for their distribution as appeared to him best calculated to stimulate the exertions of philosophers, and to associate for ever the results of their labours with the publication of the Transactions of the Royal Society.

The Council availed themselves of the earliest opportunity which the resumption of their meetings allowed, to present, in the name of the Fellows of the Royal Society, the homage of their loyalty and devotion to the person and throne of the illustrious Princess who now wields the sceptre of this great empire; and they ventured at the same time to express a hope that Her Majesty would be graciously pleased, in conformity with the practice of her predecessors, to sign her royal name in our Register as Patroness of our Society, and that she would likewise continue to us the annual grant of the two Medals which had been made by King George the Fourth and King William the Fourth.

This Address has been presented to Her Majesty, who has been graciously pleased to signify to me, through the Secretary of State, that she is most sensible of the loyalty and attachment expressed in it, and that she cordially joins in the wish of the Royal Society that her reign may be distinguished by the triumphs of the arts of peace and by the general diffusion and advancement of religion and knowledge amongst all classes of her subjects. Her Majesty was further graciously pleased to intimate that she would have great satisfaction in becoming the Patroness of the Royal Society, and that she would annually place at their disposal two Gold Medals, and would continue to extend to them the same protection and patronage which they had received from her royal predecessors.

I feel proud, Gentlemen, in being able to communicate to you these gracious assurances of support and protection from our Patroness and Queen, which are well calculated to confirm, though they cannot increase, the loyal and devoted attachment which we feel to her person; and I trust that I shall be able, at no distant period, to announce to you that Her Majesty has signed her royal name in our Register as Patroness of the Royal Society.

I now proceed to notice some of the more important events connected with the administration of the Royal Society during the last year.

One of the Royal Medals has been adjudged to Mr. Whewell for his very valuable series of researches on the tides, which have been published in our Transactions, chiefly during the last three years. I must refer you, Gentlemen, for a statement of the grounds upon

which this decision has been founded to the more detailed reports of the Council, which will be read to you by your Secretary Dr. Roget; but I gladly avail myself of this opportunity of expressing my respect for the great talents and varied attainments of the distinguished philosopher upon whom this mark of honour has been conferred. If I regard him as occupied with the highest and most important practical duties connected with our system of academical education, and in providing and arranging the materials by which it is conducted, or the principles upon which it should be based, he will be found in the foremost rank of those whose labours do not deserve the less honour because they commonly absorb the entire time and attention of those who are engaged in them, and thus close up the avenue to those distinctions which are almost exclusively confined to great discoveries in science, or to important productions in literature. When I read his essays on the architecture of the middle ages, on subjects of general literature, or on moral and metaphysical philosophy, exhibiting powers of mind so various in their application and so refined and cultivated in their character, I feel inclined to forget the profound historian of science in the accomplished man of letters, or the learned amateur of art; but it is in his last and highest vocation, whilst tracing the causes which have advanced or checked the progress of the inductive sciences from the first dawn of philosophy in Greece to their mature development in the nineteenth century, or in pointing out the marks of design of an all-wise and all-powerful Providence in the greatest of those works and operations of nature which our senses or our knowledge can comprehend or explain, that I recognise the productions of one of those superior minds which are accustomed to exercise a powerful and lasting influence upon the intellectual character and speculations of the age in which they flourish.

It is now three years since the Royal Medal was adjudged to Mr. Lubbock for his Researches on the Tides; and the Council have availed themselves of the first opportunity which was presented by the recurrence of the cycle of the subjects, which are successively entitled to the Royal Medals, to make a similar award to his colleague and fellow-labourer in this very interesting and important series of investigations. It is not for me to attempt to balance the relative claims and merits, in connection with this subject, of these two very eminent philosophers; it is quite sufficient to remark that the first who ventured to approach this difficult and long-neglected inquiry was the first also who was selected for honour: but I have long noticed with equal pride and satisfaction the perfect harmony with which they have carried on their co-ordinate labours, apparently indifferent to every object but the attainment of truth, and altogether superior to those jealousies which too frequently present themselves amongst rival and cotemporaneous labourers in the same departments of science.

I regret to observe that the second Royal Medal for the present year has not been awarded, and that it has consequently lapsed to the Executors of his late Majesty. It was proposed that it should be

given to the best Memoir presented to the Royal Society between the years 1834 and 1837, containing "Contributions towards a System of Geological Chronology, founded upon an examination of Fossil Remains and their attendant Phænomena;" a subject of the greatest interest, and also of the greatest delicacy, from its connexion with those agitating topics which the speculations of philosophers are compelled to approach, though they may not always venture to decide. I should have rejoiced to have seen in the Transactions of the Royal Society a record of the opinions of a Buckland or a Sedgwick upon a theme which is so worthy of the application of their highest powers; and I trust that, though its announcement as a Prize Question has failed to secure, within the prescribed period, the accomplishment of the object proposed by it, it will still have done some service to the cause of science by exciting the attention of geologists in such a manner as may sooner or later lead to a definite and philosophical exposition of their views on a subject of so much importance.

Those who have attended to the Tidal researches of Mr. Whewell must be aware how much light has been thrown upon the character and course of the phænomena of the tides by the simultaneous observations, under his instructions, which were made in the month of June, 1834 and 1835, at nearly five hundred stations of the Coast Guard Service in Great Britain and Ireland, and simultaneously with the latter also at more than one hundred stations in America, Spain, Portugal, France, Belgium, Holland, Denmark, and Norway. These observations were undertaken by the authority or through the influence of the Government of this country, which likewise most promptly and liberally furnished the requisite funds and assistance for reducing the observations in such a manner as was requisite for deducing general conclusions from them, a labour much too extensive and costly to be undertaken by any single individual. I gladly seize this opportunity of bearing testimony, occupying as I do the highest scientific station in this country, to the readiness which the Lords of the Treasury and the Admiralty have shown on this and on every other occasion to forward scientific inquiries, and particularly such as are connected with the advancement of astronomy and navigation. They have granted funds for reducing and publishing the Planetary Observations at Greenwich, the valuable and extensive series of observations of the late Mr. Groombridge, for repeating upon an adequate scale the very important experiments of Mr. Cavendish, and for many other subjects of great scientific interest and value; and I feel satisfied that every application for assistance towards the accomplishment of any important object in science, will receive from them the most willing attention and support, if it comes before them with the recommendation and authority of those persons who are most competent to judge of its usefulness or necessity, and in such a form as may justify them in appealing to Parliament for its sanction of the requisite expenditure. I rejoice, Gentlemen, in such manifestations of the sympathy of the Government of this great

country for the progress of science, and I trust that its influence will be felt in the cordial union and co-operation of philosophers in planning and in executing those great systems of observations, whether simultaneous or not, which are still requisite to fill up some of those blank spaces which occupy so large a portion in the map of human knowledge.

In the course of last year the celebrated Baron de Humboldt addressed a letter to me, as President of the Royal Society, expressing a wish that Magnetical Observatories, upon a uniform plan, might be established in this country and its colonies, with a view of making simultaneous observations with those which are now making, or which are in progress to be made, in different parts of the continent of Europe and of Northern Asia. I felt it to be due to the illustrious author of this communication to make it generally known to the Fellows of the Royal Society, and to beg that a committee of the Council might be appointed to consider the best mode of carrying its recommendations into effect. A very elaborate Report was consequently made by the Astronomer Royal and Mr. Christie in November last, enumerating many important consequences which might result from such a system of observations, and pointing out a series of stations where they might most efficiently be made. I am happy to inform you, Gentlemen, that measures are in progress for the accomplishment of all these objects: a Magnetical Observatory, which was long contemplated and earnestly recommended by the Board of Visitors of the Royal Observatory, has been established at Greenwich, in a situation so remote from all other buildings as to be altogether free even from the suspicion of external disturbances. The Corps of Royal Engineers, which has always been distinguished for the zeal and scientific acquirements of many of its Members, has spontaneously offered to conduct the requisite observations, in whatever quarter of the globe they may be stationed; the Astronomer Royal has determined the species of observations to be made, and the character and construction of the instruments to be used; and the Lords of the Treasury have placed at the disposal of the Royal Society the requisite funds for their purchase. I have felt it my duty, Gentlemen, to bring these circumstances under your notice, not merely as forming an important part of the proceedings of the Council of the Royal Society during the last year, but as an encouraging and instructive example of the facility with which extensive co-operation and assistance may be obtained in the execution of any scientific object, however extensive it may be, when the practical means for performing it are distinctly and clearly defined.

It is with real concern that I venture to call your attention to a letter which has been recently published, on the subject of the new Catalogue of the Library of the Royal Society, which I somewhat prematurely announced, when I last had the honour of addressing you, as preparing for publication, and as likely very shortly to appear. I was perfectly aware, when I made that announcement to you, of the nature of the correspondence which had passed between Mr. Panizzi and the Council relating to this Catalogue; but I had

no suspicion that the very brief allusion which I made to this subject, or the incidental mention of Mr. Panizzi's name, which I made in no offensive or disrespectful sense, would have been considered sufficient ground for its publication. It is not my intention to make any observations on the particular allegations which are made against the Council, both collectively and individually, in Mr. Panizzi's letter, which will be more properly noticed in a short statement, which has been drawn up, in deference to your good opinion, by the Council, and which will be read to you by Dr. Roget*; but I think it my duty to state to you, that I was not only cognisant of the whole course of the proceedings of the Council at the time when they took place, but that I perfectly concurred in their propriety; and I beg leave further to assure you, that a careful perusal of Mr. Panizzi's correspondence with the Council, of his comments upon their resolutions and of his imputations upon their conduct, has in no respect tended to modify the opinion which I originally formed, or to induce me to withdraw from the full share of responsibility which I incur, in connection with these proceedings, in common with every other Member of the Council.

Before I conclude this portion of my address, I feel it to be my duty to notice the retirement of Mr. Children and Mr. König from the offices which they have so long and so ably filled. The increasing duties, which have been imposed upon them by recent regulations at the British Museum, have been deemed by them in some degree incompatible with those which they owe to the Royal Society; and they have determined therefore, with a promptitude and delicacy of feeling which does them honour, to retire from their official connexion with us. It is quite unnecessary for me to enlarge upon the merits of two gentlemen who are so well known to you by their labours in your service, by the courtesy of their manners and by the extent and variety of their acquirements; but I should do injustice to my own feelings if I did not express, in the strongest terms, my personal obligations to them for their kind attention to my wishes, and for the anxiety which they have always shown that the interests of the Royal Society should not suffer from my occasional inability to attend personally to the discharge of the duties of my office. I am quite sure, Gentlemen, that I do not misinterpret your feelings, when I propose to thank them, in your name and my own, for their long and valuable services.

The Society has lost during the last year twenty-nine Members on the Home, and two on the Foreign List, and I shall now proceed to notice some of the most distinguished names which appear amongst them.

Henry Thomas Colebrooke was the son of Sir George Colebrooke, an eminent Director of the East India Company, under whose auspices he proceeded to India, as a writer, in 1782. Though a severe student in youth, and strongly disposed to follow a learned profession at home, he gave no indications for many years after his

* This statement is given in page 18.

arrival in India of those tastes for severe and abstract studies for which he was afterwards so celebrated; and we consequently find that, whilst resident at Purneah, he devoted much of his time to the wild and animating field-sports of the East, for which he long retained a passionate fondness. He made his first appearance as an author in 1792, in a Treatise on the Agriculture and Commerce of Bengal; and it was about this period that he began, with all the ardour and energy which distinguished his character, the study of the Sanscrit language, chiefly with a view to acquire a knowledge of the Lilawati and other Sanscrit treatises on Algebra and Astronomy, which the somewhat extravagant speculations of Bailly and others had begun to bring into notice. He subsequently undertook the translation of the Digest of the Hindu Laws of Contracts and Successions, which had been compiled under the direction of Sir William Jones, a most laborious and difficult task, which he completed in less than two years. It was during his engagement on this work that he was appointed to a judicial situation at Mirzapore, a position singularly suited to his tastes and pursuits, from its vicinity to Benares, the great repository of the ancient treasures of the literature of Hindostan, and the place of residence of its most learned expounders.

In the year 1800 he was removed to Calcutta, and raised to the highest judicial situation in the native courts of India, at the same time that he was made President of the Board of Revenue, Member of the Supreme Council, and Honorary Professor of Sanscrit in the College of Fort William. But the important official duties which he was thus called upon to discharge seem rather to have stimulated, than to have checked, his labours and investigations in oriental literature and oriental science. In the course of a few years there appeared from his pen many profound dissertations in the Asiatic Researches, on the Vedanta System of Philosophy, on Sanscrit and Pracrit Poetry and Grammar, on the Indian Classes, on the Origin and Tenets of the Mahometan Sects, on the Jains, on the Indian and Arabian Division of the Signs of the Zodiac, and on the Notions of the Hindu Astronomers on the Precession of the Equinoxes and the Motions of the Planets; to which must be added the first volume of a very elaborate Sanscrit Grammar, the translation of the Peostra, a Sanscrit Dictionary, and two extensive Treatises on the Hindu Law of Inheritance, together with editions of the Amera Cosha, a Sanscrit Vocabulary, and of the Hitópadésá, or " Salutary Instruction", which had been translated by Mr. Wilkins, and which is more commonly known under the name of the " Fables of Pilpay".

It was some time after Mr. Colebrooke's return to this country that he published, in 1817, a translation of the Lilawati and Vija-Ganita, Sanscrit treatises on arithmetic, algebra and mensuration, to which was prefixed a dissertation on the early history of algebra and arithmetic in India, Arabia and Italy, which is equally remarkable for its profound knowledge of Hindu and Arabian literature and its correct views of the relations of oriental and ancient and mo-

dern European science. He was also the first person who maintained, from his own observations on the plains of Hindostan, the superior elevation of the Himalayan mountains above the Andes of America, in opposition to the opinions generally entertained at that period, and which had been sanctioned by the great authority of Humboldt's theory of the range of the curve of perpetual congelation. The complete confirmation which his opinion afterwards received, from accurate barometrical and trigonometrical measurements, was always referred to, in his later years, with particular satisfaction and triumph.

Mr. Colebrooke continued the steady pursuit of his oriental and scientific studies until nearly the close of his life, and even when the progress of his infirmities confined him almost entirely to his bed. He was one of the founders of the Asiatic and Astronomical Societies, and a short time before his death he gave to the library of the India House his incomparable collection of Sanscrit and Asiatic manuscripts, which had been collected at an expense of nearly 10,000*l.*, with the noble view of preserving them for ever from the danger of dispersion by the fluctuating accidents of inheritance.

Mr. Colebrooke was probably, with one single exception, the greatest Sanscrit scholar of his age; and when we take into account his great acquirements in mathematics and philosophy and in almost every branch of literature, combined with the most accurate and severe judgement, and also his great public services in situations of the highest trust and responsibility, we shall not hesitate to pronounce him one of the most illustrious of that extraordinary succession of great men who have adorned the annals of our Indian empire, the deaths of so many of whom it has been my misfortune to record in my recent addresses from this chair.

Dr. John Latham reached the extraordinary age of ninety-seven years, having enjoyed the full possession of his faculties and almost unbroken health until within a few days of his death: he was the father of the Royal and Antiquarian Societies, and it is sixty-seven years since his first paper, on a medical subject, was published in our Transactions. He was the author of many papers on antiquarian subjects; but his favourite study throughout life was natural history, and particularly ornithology. He published, in 1781, his General Synopsis of Birds, in six volumes quarto, and afterwards two supplementary volumes. In 1792 he published his Index Ornithologicus, a complete system of ornithology, arranged in classes, orders, genera and species, in two volumes quarto. At the age of 82, he commenced his General History of Birds, a magnificent work in eleven volumes quarto. He was a man of very systematic habits and most amiable character, the tranquil course of whose long life was neither disturbed by scientific or professional jealousies, nor embittered by the want of those enjoyments which competence and domestic happiness and virtue alone can confer.

Dr. Tiarks was born at Jever in Oldenburg, and came to England in 1810, when he was appointed Assistant-Librarian to Sir Joseph Banks, through whose influence he was nominated Astronomer to the Commission for settling the North American Boundary, under

the authority of the Treaty of Ghent. After his return to England; in 1822, he was commissioned by the Admiralty, at the request of the Board of Longitude, to ascertain, by means of a great number of chronometers, the difference of the longitudes of Falmouth and Madeira, and subsequently of Falmouth and Dover, the results of which were detailed in a very able paper in our Transactions for 1824, in which he pointed out and explained the origin of an error of nearly 4″ of time in the longitudes of all the stations of the Trigonometrical Survey. He was afterwards sent on a similar mission to Heligoland and various stations in the North Seas, and on the last occasion he was accompanied by Sir Humphry Davy, who wished to try the effect of his protectors on the corrosion of the copper sheathing of ships. In 1825 he was recalled from Germany to resume his astronomical surveys in America, where he was employed to ascertain the position and extent of the north-western boundary of the Lake of the Woods, an operation in the execution of which both he and the party who assisted him suffered the greatest hardships and privations. He published various reports of his surveys, and was necessarily much employed and consulted in the difficult and embarrassing negotiations which have attended, and unhappily still attend, the settlement of the important question of the North American boundaries. Dr. Tiarks died in the forty-eighth year of age, at his native place, in consequence of a fever which attacked a constitution already shattered and broken by the severe labours and privations which he had endured. He was a mathematician of no inconsiderable attainments, a very careful and efficient practical astronomer, and admirably qualified for the very important and responsible duties which he was appointed to discharge.

Dr. Edward Turner was a native of Jamaica, and studied medicine at Edinburgh, and chemistry at Göttingen under the instructions of the celebrated analytic chemist Stromeyer. He became a lecturer on chemistry at Edinburgh in 1824, and his first publication was a short introduction to the study of the laws of chemical combination and the atomic theory. He obtained the Professorship of Chemistry in the London University at its first establishment in 1828, a situation which he continued to hold to the end of his life. His Elements of Chemistry have enjoyed an uncommon degree of popularity, and are remarkable for clearness and precision both in the description of his experiments and in the deduction of his theory. He was the author of two papers in our Transactions; the first "On the Composition of the Chloride of Barium," and the second containing "Researches on Atomic Weights," both written with a view of impugning the theory which had been promulgated by some English chemists of high authority, "that all atomic weights are simple multiples of that of hydrogen." In the year 1835 Dr. Turner was compelled by the declining state of his health to suspend all original researches, confining himself simply to the duties of his professorship, and he died in February last, in the fortieth year of his age, to the deep regret of every friend of the progress of chemi-

cal science. He was a person of most engaging manners and appearance and of most amiable character; and his body was followed to the grave, with every manifestation of respect and affectionate attachment, by the whole body of the pupils and professors of the institution of which he had so long been a principal ornament.

Dr. William Ritchie was originally Rector of the Royal Academy of Tain in Inverness-shire, where he contrived, by extreme frugality, to save a sufficient sum from his very small annual stipend to attend a course of the lectures of Thenard, Gay-Lussac, and Biot at Paris, and also to provide a substitute for the performance of his duties during his temporary absence from Scotland. His skill and originality in devising and performing experiments with the most simple materials, in illustration of various disputed points of natural philosophy, attracted the attention of the distinguished philosophers whose occasional pupil he had become: he had also communicated, through Sir John Herschel, who took a strong interest in his fortunes, to the Royal Society, papers "On a new Photometer," "On a new form of the Differential Thermometer," and "On the Permeability of transparent Screens of extreme tenuity by Radiant Heat," which led to his appointment, through the recommendation of Major Sabine, to the Professorship of Natural Philosophy at the Royal Institution, where he delivered a course of probationary lectures in the spring of 1829: he became, from this time, a permanent resident in London, and was appointed to the Professorship of Natural Philosophy at the London University in 1832. He subsequently communicated to the Royal Society, papers "On the Elasticity of Threads of Glass, and the application of this property to Torsion Balances;" and also various experimental researches on the electric and chemical theories of galvanism, on electro-magnetism and voltaic electricity, which are more remarkable for the practical ingenuity manifested in the contrivance and execution of the experiments, than for the influence of the views which they display on the progress of their theory, which was so fully and so happily developed by the cotemporary labours of another illustrious chemist and philosopher. Dr. Ritchie was subsequently engaged in experiments, on an extensive scale, on the manufacture of glass for optical purposes, for the examination of the results of which a Commission was appointed by the Government, with a view to their further prosecution by a public grant of money, or by affording increased facilities of experiment by a relaxation of the regulations of the Excise. A telescope of 8 inches aperture was made by Mr. Dollond from Dr. Ritchie's glass, at the recommendation of this commission; but it is generally understood that its performance was not so satisfactory as to sanction a further expenditure in the extension of these experiments. Dr. Ritchie died in the autumn of the present year, of a fever caught in Scotland; and though the traces of an imperfect and irregular education are but too manifest in most of his theoretical researches, yet he must always be regarded as an experimenter of great ingenuity and merit, and as a remarkable example of the acquisition of a very extensive knowledge of philosophy under difficulties and privations

which would have arrested the progress of any person of less ardour and determination of character.

Mr. Joseph Sabine was educated in the University of Dublin, and devoted himself, from a very early period of life, to the study of botany, ornithology, and other branches of natural history, to the neglect of those professional studies which his friends designed him to pursue. One of his earliest labours was the formation of a collection of British birds of almost unrivalled extent and completeness. He became secretary to the Horticultural Society at the period of its first establishment; and though his connection with it was afterwards very abruptly and perhaps very harshly terminated, he must always be considered as the chief author of its successful and complete development. To the Horticultural Transactions he contributed 64 papers, the most important of which are those on the genera *Crocus*, *Dahlia*, and *Chrysanthemum*; and he was also required to re-write the greatest part of the communications which were addressed to the Society by gardeners and practical men, which were rarely sent in a fit state for publication, but which frequently embodied very important information on the various processes of horticulture.

Mr. Sabine was likewise an active and valuable member of the Zoological Society, whose gardens are chiefly indebted to his taste and knowledge for the introduction and systematic arrangement of those splendid flowers and shrubs which have added so greatly to their beauty and interest.

Mr. Sabine held, for the greatest part of his life, the situation of Inspector-General of Taxes, and was called upon by his official duties to make periodical visits to almost every part of the kingdom; he never omitted any opportunity which his various journies afforded him, of acquiring or of communicating practical knowledge of horticulture and of botany; and few persons have contributed so much, by their personal exertions, to add to the decorations of the cottage and the park, to increase and improve the produce of our gardens, and thus greatly to extend the sphere of the innocent enjoyments and luxuries of all classes of society.

The Rev. Dr. Joseph Hallett Batten was a native of Penzance in Cornwall, and was elected a Fellow of Trinity College, Cambridge, in 1801, after attaining very high academical honours. He was appointed Classical Professor at the East India College at Hayleybury at the period of its first establishment, and became Principal of the college upon the retirement of Dr. Henley, a situation which he continued to retain until within a month of his death. He was a man of cultivated taste and of very extensive attainments, both in theology and general literature; and in every way worthy, by his intellectual powers and character, of presiding over an establishment which has been so justly distinguished by the very eminent men who have been, and now are, connected with it.

Dr. John Johnstone was the sixth son of the celebrated Dr. James Johnstone of Worcester, and received his education at Merton College, Oxford. He was for upwards of forty years a very distin-

guished physician at Birmingham and its neighbourhood, and made his first appearance as an author in a defence of his father's claim to the first discovery of the disinfecting powers of muriatic acid gas, which had been claimed by Dr. Carmichael Smyth. Though earnestly attached to the study and practice of his profession, he retained throughout life a fondness for classical literature, and lived on the most intimate terms with some of the most distinguished scholars of the age, including amongst their number the justly celebrated Dr. Parr, whose life and voluminous correspondence he published, a work full of interesting literary anecdote and classical research; and his Harveian oration, pronounced in 1819, and which has been recently published, with a short memoir of his life, by his friend the Bishop of Lichfield, is a model of spirited and correct Latinity. Dr. Johnstone was a man of very warm affections and of great independence of character, and he was universally respected in the great manufacturing city in which he resided, for his great professional skill and services, and for the active support which he gave to every benevolent and useful institution.

Sir John Soane received his early architectural education under Mr. Dance and Mr. D. Holland, and was afterwards sent, by the especial bounty of King George the Third, as a student of the Royal Academy, to pursue his professional studies at Rome. After his return he gradually obtained extensive employment, both as an architect and a surveyor, and finally succeeded in securing almost every important and honourable appointment which is connected with the exercise of his profession in this country. In later life, when in possession of an ample fortune and public honours, he became a most munificent patron of public institutions, and more particularly of those which are connected with the advancement of the fine arts; and in 1835 he bequeathed his house in Lincoln's Inn Fields, and the magnificent collection of works of art which it contained, to the nation, and secured the accomplishment of this noble project by an Act of Parliament; he continued to pursue his usual course of public munificence until his death, which took place on the 20th of January last, in the 84th year of his age.

Sir John Soane was profoundly acquainted with the great principles of his art, and many of the interiors as well as exteriors of his buildings are remarkable for skilful construction and for rich and harmonious effects; but he was unfortunately disposed, in some cases, to seek for novelty rather in new forms and decorations of architectural members, than for originality in the combination of those which have been sanctioned by the concurrent voice of the most cultivated of ancient nations and the greatest masters of modern art; it is for this reason that many of his works appear somewhat capricious and extravagant, and fail to produce that undefinable feeling of pleasure and satisfaction which always attends the contemplation of those great productions of architecture which have been celebrated for correct proportions, or for beautiful and appropriate decoration.

In connexion with this distinguished professor and patron of art,

I feel myself called upon to allude to the name of the venerable Earl of Egremont, whose very recent loss we have to deplore. He was a nobleman distinguished by his active yet discriminating benevolence, and by his princely use of a princely fortune; but it is as a judge and patron of art that his loss will be most severely felt beyond the precincts of his own family and the numerous poor who were the immediate partakers of his bounty. He was equally judicious in the selection of subjects for artists to execute, and liberal in rewarding them when done.

Mr. J. D. Broughton, Surgeon of the Life Guards, had served with great distinction as a medical officer during a great part of the Peninsular war and at Waterloo. He was an eminent physiologist, and devoted a great portion of his time and attention to the study and improvement of the science of medical jurisprudence, and more particularly to experiments on the effects of poisons, and to the best and most unerring tests for detecting their presence after death. His death, which followed a serious operation, rendered necessary by a long-neglected accident, was deeply lamented by a large circle of friends, by whom he was equally respected and beloved for his great professional talents and for his honourable character.

Mr. John Davidson, the last known victim to the cause of African discovery, was formerly a partner in the house of Messrs. Savory and Moore, the well-known chemists, but was induced to quit it in 1826, partly with a view to gratify his passion for foreign travel, and partly from other causes. He afterwards visited North and South America, India, Palestine, Turkey, Greece, Italy, Germany, and France; and the lectures which he gave at the Royal Institution and elsewhere, after his return, on the pyramids of Memphis and Mexico, on Thebes and the temples of Egypt and Jerusalem, afforded a sufficient proof both of his activity and of his accurate observation. The spirit of enterprise and travels, when once excited, is not easily allayed, and Mr. Davidson devoted himself, almost from the period of his return to this country, to a course of preparation for a journey to Timbuctoo, which had already proved fatal to so many adventurers. He was accompanied on this journey by Abu-Bekr, an enfranchised African slave, who had been a prince in his own country when young, and was well acquainted with the Arabic language. He had penetrated from Wadnoon to within twenty-five days' journey of Timbuctoo, when he was murdered by the El Hareb tribe, who were suspected to have been hired for that purpose by Moorish merchants, who, from not being able to understand or conceive the real motives of such an undertaking, conceived that its success would be injurious to their interests. Mr. Davidson was a man of great activity and strength, in the full vigour of life and health, and able to endure the severest labours and privations; but personal accomplishments the most calculated to secure success in ordinary attempts of this nature, serve only to augment the suspicion and to stimulate the cruelty of those savage tribes, who tyrannize over these inhospitable and almost impenetrable regions, and who are described by his companion, Abu-Bekr, "as

full of envy at a stranger's goods; they lie in wait to plunder him of every thing, as a lion lieth in wait for the cattle; they have no mercy on the stranger; even if a stranger were to strip off his skin and to give it to them, they would seize upon it."

The only Foreign Members whom the Society has lost during the last year are Dr. Adam Afzelius, of Upsala, and Professor Morichini, of Rome.

Dr. Adam Afzelius was born at Larg in West Gothland in 1750, and was one of the last surviving pupils of Linnæus. In 1777 he was appointed Reader of Oriental Literature and in 1785 Demonstrator of Botany in the University of Upsala, and he made his first appearance as an author by the publication of a short supplement to the *Flora Suecica* of his master, in the Transactions of the Academy of Stockholm for 1787. In the years 1792 and 1794, he made botanical expeditions to Guinea and Sierra Leone, and a considerable part of the collections which he formed in those countries passed subsequently into the herbariums of Sir Joseph Banks and Sir James Edward Smith. In 1797 he was made Secretary of Legation to the Swedish Embassy in this country, and in the following year he was elected a Foreign Member of the Royal Society on the ground of his great knowledge of botany and zoology. Upon his return to his own country, he became Professor of Materia Medica and Diætetics, at Upsala, situations which he retained for the remainder of his life. He was the author of a learned paper in the Linnean Transactions for 1791 on the genus Trifolium, and also of two works entitled *Remedia Guinensia* and *Stirpium in Guinea medicinalium species*: he edited likewise the botanical Correspondence of Linnæus. He was a botanist of great learning and acquirements, and highly esteemed by the leading founders of the Linnean Society; but I am unable to connect his name with any considerable advancement in natural knowledge.

Professor Morichini, of Rome, was elected a Foreign Member of the Royal Society in 1827, and is chiefly known for his experiment on the magnetizing influence of the violet rays in the solar spectrum. His experiment was repeated by Configliachi at Pavia, and by Berard at Montpellier, without success, and in consequence doubts were expressed of the accuracy of his results, which appeared to be finally removed by the successful repetition of it by our justly celebrated countrywoman Mrs. Somerville, in the summer of 1825. I am not aware however that any other philosopher has succeeded in a similar attempt.

Statement of the Council relative to Mr. Panizzi's Pamphlet.

In the pamphlet recently published by Mr. Panizzi, entitled "A Letter to His Royal Highness the President of the Royal Society, on the New Catalogue of the Library of that Institution now in the press," all the charges brought forward against the Council are founded on the most unwarranted and erroneous assumptions.

Mr. Panizzi, assumes, in the first place, that the Council was bound to pay him *in advance* the remuneration agreed upon for the completion of the Catalogue; such payment in advance never having been for a moment contemplated. His payment was to have been at the rate of £30 for every thousand titles the Catalogue might contain; but, in consideration that the work would probably require a long time to accomplish, it was agreed that one third of the money should be given to him when he had written out all the titles on slips of paper, another third when the revises were finally corrected for the press, and the remaining third when the whole was printed off. The total number of titles written out by Mr. Panizzi, as counted by Mr. Shuckard, by whose computation he consented to abide, was found to be 24,136; which at the rate of £10 per thousand, would render the sum he ought to have received at the present stage of his work, £241 : 7*s.* 2*d.*, but from this sum £27 : 6*s.* is to be deducted in payment of Mr. Roberton, as had been agreed to by Mr. Panizzi, reducing it to £214 : 1*s.* 2*d.* At the period when Mr. Panizzi discontinued the work he had already received from the Society £450 *on account*, which is more than double the sum to which he was then strictly entitled. The Council, therefore, far from imagining that he had any further claims on the Society, considered that in advancing him so large a sum before he had completed the second term of his engagement, they had rather erred on the side of liberality. They could never have had an idea that he expected any additional payment, as he never gave them the slightest intimation to that effect; and it is not until after the lapse of sixteen months that he suddenly makes an appeal, not to the Council of the Royal Society, but to the public, by the circulation of a pamphlet, claiming further remuneration, which he has never applied for to the party from whom he imagines it to be due.

In the second place, Mr. Panizzi assumes that the slips and revises are his own property, and that the Council has no right to them; and to such a length does he carry this notion, that, even after he had ceased to be employed by the Council, he refused to give up the key of the drawers containing the slips, as if that key were his own property. He likewise still withholds the revises containing the remarks of the Members who had seen them, alleging, while accused by nobody, that they were necessary for his justification. He is evidently not warranted in complaining of Members pointing out what appeared to them to be errors, for if he had deemed this wrong he would not have done the very same thing in his pamphlet, wherein he subjects the sheets of a former Catalogue, not designed for publication and in a very rough and unfinished state, to the ordeal of his severest criticism.

Another of Mr. Panizzi's unwarranted assumptions is his fancying himself at liberty to execute the work on which he was employed in whatever manner he pleased. The Council certainly never delegated to him this power; but appointed a Committee for the express purpose of superintending the work as it proceeded, and of regulating the manner in which it should be printed: and it was the

duty of Mr. Panizzi, or whoever else might have been employed by the Council, to follow the directions and instructions which might from time to time be given to him by that Committee.

Mr. Panizzi was continually complaining of ill usage, while he at the same time did not disclose the nature of his supposed injuries. He stated that he could not proceed with the work, but would not point out any ground of complaint. When requested to explain wherein he thought himself aggrieved, he would give no definite answer to the inquiry, but proposed to refer matters to an arbitration; leaving the Council all the while unacquainted with the subjects of dispute, or with the points to be settled by such arbitration. When, for the purpose of mutual understanding, he was invited to a conference with the Committee, he refused to meet them, and would only communicate by letter with the Council*.

Finding, at length, that the great cause of the offence taken by Mr. Panizzi consisted in his being directed by the Committee to omit certain comments and notes which he had introduced, in his own name, in the Catalogue, the Council, in deference to his wishes, and in the spirit of conciliation, conceded the point in dispute, and agreed that he might consider the manuscript corrections made by the members of the Committee, merely "as suggestions for his guidance." But, far from meeting them in the same spirit, he next required of the Council, as a condition without which he could not proceed with the Catalogue, a further concession, namely, that they should rescind the whole resolution of its Committee, and declare it null and void. It was obviously impossible to comply with so unreasonable a demand, which seemed so like a mere pretext for the total abandonment of the work: and no alternative remained but to pass the resolution of the 14th July, "that Mr. Panizzi be no longer employed in the formation of the Catalogue."

On the Council requesting the return of the revises in his possession, Mr. Panizzi refused to do so, alleging that they are his private property; nor would he even deliver up the key of the drawers containing the manuscript slips; refusals which, of course, put an end to all further correspondence with him on the part of the Council.

So far from the Council having ever withheld from Mr. Panizzi, as he asserts in his pamphlet they have done, the precise number of titles which he wrote for the Catalogue, they have always been ready to afford him that information. The slips were carefully counted by Mr. Shuckard, in whose accuracy Mr. Panizzi placed the fullest reliance, and who was appointed for that purpose with

* *Note by Mr. Baily.*—Mr. Panizzi having stated in his letter to the Secretary, of July 8th (see his pamphlet, page 38) that "Mr. Baily took away my written "memorandum, and ordered Mr. Roberton not to take any step," I beg to remark, first, that, *when that letter was read* at the Council, I was surprised at the assertion, and distinctly denied the fact, never having seen nor heard of the written memorandum therein referred to: secondly, that Mr. Roberton was immediately called before the Council, and, on being questioned as to this subject, disclaimed also any knowledge of the circumstance.—Francis Baily.

his concurrence. Any inquiry that Mr. Panizzi might have chosen to make as to the results and details of that computation would, at all times, have received the most immediate and complete answer.

Report of the Proceedings of the Council for the past year.

The principal business of public interest which has occupied the attention of the Council relates to the extension of accurate magnetical and meteorological observations in different parts of the world.

A communication having been made by Lieut. William Denison, of the Royal Engineers, of a proposal from General Mulcaster, Inspector-General of Fortifications, that the officers of engineers generally should be employed, under the direction of the Royal Society, in promoting the advancement of science, by carrying on connected series of observations relating to Natural History, Meteorology, Magnetism, and other branches of physical science, and suggesting an application to Government for a grant of funds necessary for effecting so desirable an object; a Committee was appointed to consider of the proposed measure, and of the means of carrying into effect the recommendations contained in the letter of Baron Von Humboldt, addressed in April last to His Royal Highness the President. Conformably with the report made by this Committee, the Council fixed on the ten following places, namely, Gibraltar, Corfu, Ceylon, Hobart Town, Jamaica, Barbadoes, Newfoundland, Toronto, Bagdad, and the Cape of Good Hope, as being the most eligible for carrying on magnetic observations according to the plan recommended by Baron Von Humboldt; those places being permanent stations, where officers of engineers and clerks are always to be found. The Council also determined that, for the present, the observations of magnetism may be limited to those of the direction of the magnetic needle, and the meteorological observations restricted to those made on the four days, and in the manner recommended in Sir John Herschel's instructions.

A grant of 500*l.* from the public funds has since been obtained from the Lords Commissioners of Her Majesty's Treasury, in aid of the purchase of the necessary instruments for carrying on the magnetic observations, according to the plan proposed by the Committee, and under the directions of the Royal Society.

A statement having been also laid before the Council by Mr. Christie of the importance of a more accurate determination than has hitherto been made of the variation of the magnetic needle at several points on the coasts and in the interior of Great Britain and Ireland, and likewise of the dip and of the intensity of terrestrial magnetism, the Council, fully concurring in these views, presented to the Lords of the Admiralty a strong recommendation that steps should be taken for carrying into effect the course of observations pointed out by Mr. Christie; and their Lordships have in consequence appointed a Committee to meet and examine into this important subject.

The Council having deemed it desirable that the difference of level

between the brass mark fixed by Capt. Lloyd on the north-east landing stairs of the New London Bridge, and Mr. Bevan's mark on the basement of the pilasters of the north-east landing stairs of Waterloo Bridge, should be accurately determined, requested Sir John Rennie to undertake this determination. Sir John Rennie has reported to the Council that, after repeated trials, the greatest variation of which did not exceed two-tenths of an inch, he found that the mark on Waterloo Bridge is 3 feet and 1·65 inches above that on New London Bridge.

The Council have awarded the Copley Medal of this year to M. Becquerel for his various Memoirs on the subject of Electricity, published in the "Mémoires de l'Académie Royale des Sciences de l'Institut de France", and particularly for those on the production of Crystals of Metallic Sulphurets and of Sulphur, by the long-continued action of electricity of very low tension, and published in the tenth volume of those Memoirs.

Among those who have been engaged in investigating the phænomena of electricity, M. Becquerel holds an eminent rank, and the Memoirs of the Royal Academy of Sciences of Paris bear ample testimony to the success which has attended his researches in this department of science. He appears early to have been sensible that, for the detection of phænomena which may occur at the instant of incipient molecular attraction, and which become masked by the more general effect of the transfer of the elements when powerful electric currents are employed, it was necessary to substitute for these currents of very low tension*. Following out this view, carefully adjusting the strength of the current to the power of the affinities brought into action, he succeeded, by electric decomposition, and by subsequent recomposition of the elements, in obtaining crystals of some of the metallic sulphurets, of sulphur, of the iodurets of lead and copper, of the insoluble sulphates of lime and barytes, of the carbonate of lead, and other substances, a few of which had previously, by other means, been obtained crystallized, but of which the great majority had only been recomposed in an amorphous state. In the Memoirs to which the Council have particularly adverted in the award of the Copley Medal to M. Becquerel, he had especially in view to explain, by the agency of electricity of very low tension, continued for an indefinite time, the occurrence of crystallized substances in mineral veins. The success with which his experiments were crowned in obtaining by such means crystals of the metallic sulphurets and of other substances, perfectly resembling those found abundantly in mineral veins, is favourable to the correctness of the views he had entertained; and these views derive additional support from the results obtained by others, in perfect accordance with his own, by means differing from those he employed, but involving precisely the same principles. Mr. Fox, in his experiments, which appear to have been

* Annales de Chimie, tome xxxiv. p. 152. Mémoire lu à l'Académie Royale des Sciences, &c., 21 Août, 1826.

conducted on a larger scale than those of M. Becquerel, endeavoured more closely to imitate the arrangements of nature, by introducing, between the substances acted on, walls of clay, in imitation of the "flucan courses" in the Cornish mines; these walls performing the same functions as the moistened clay in M. Becquerel's experiments; and he infers from his results, that the phænomena presented by the mineral veins of Cornwall are explicable on principles which are similar to those pointed out by M. Becquerel. It is thus rendered highly probable that the long-continued action of electricity of low tension has been at least one of the means by which crystallized bodies now existing in mineral veins have been produced.

But quite independently of the bearing of M. Becquerel's results on a question of great geological interest, the formation of crystals of metallic sulphurets and other substances by the agency of electricity was a great step in chemical science. As M. Becquerel very justly observes, the two branches of chemistry, analysis and synthesis, are at present in very different states. With the exception of crystals derived from aqueous solution,—which are by far the least abundant of natural crystals,—and a few from fusion, the great mass of crystallized bodies existing in nature had as yet remained inimitable by chemical processes. In the Memoirs referred to, not only are experiments described by which crystals of several of these substances have been obtained, but the principles are pointed out, by the application of which we may anticipate that large classes of others will be produced. M. Becquerel has thus opened a new field for inquiry and discovery, in which he has himself gathered the first fruits, but which still offers to future labourers the prospect of an abundant harvest of knowledge as regards both the recomposition of crystallized bodies, and also the processes which may have been employed by nature in the production of such bodies in the mineral kingdom.

A Copley Medal has been awarded to John Frederick Daniell, Esq., for his two papers on Voltaic Combinations, published in the Philosophical Transactions for 1836.

The Council are desirous of testifying, by this award, their sense of the great value of Mr. Daniell's invention of a new form of the voltaic battery, capable of producing, for a considerable length of time, a perfectly equal and steady current of electricity. The principles on which his apparatus, which he terms *the constant battery*, is constructed, were the results of a series of well-devised experiments, directed to the discovery of the cause of those great and often rapid variations in the power of the ordinary battery, which have hitherto limited its utility when employed for purposes of philosophical research, and the removal of which has greatly extended the range and multiplied the applications of this powerful instrument of chemical analysis.

The train of reasoning that led Mr. Daniell to this discovery, originated in an inquiry which he undertook with the view of determining with precision the influence exerted by the different parts of the voltaic battery in their various forms of combination. For

this purpose he contrived an apparatus which he designates by the name of *the dissected battery*, and which consists of a series of cylindrical glass vessels capable of holding the fluid electrolyte, with a pair of metallic plates immersed in it, each plate communicating below by means of a separate wire, with a small quantity of mercury, as the medium of the various communications which may at pleasure be made with other metallic parts of the apparatus. This arrangement affords peculiar advantages for studying the difference of effect in reference to the quantity and the intensity of the electric current, consequent on the different modes of connecting the elements of the battery, and also the influence of retarding forces resulting from other modes of connexion. In the course of these researches Mr. Daniell, observing the great extent of negative metallic surface over which the deoxidating influence of the positive metal appeared to manifest itself, was induced to institute a more careful examination of the circumstances attending this class of phenomena, and was led to the discovery of the gradual deposition of zinc on the platina plates being the principal cause of the progressive decline of the power of the battery. It was then that the means of counteracting this tendency presented itself to his mind. His plan consists in the constant application of a solution of sulphate of copper to the copper surface, while, at the same time, diluted sulphuric acid is constantly applied to the zinc surface, on which it exerts an oxidating and a solvent power, and is constantly renovated as it becomes charged with zinc. The two fluids are separated from one another by a partition formed of membrane, or other porous substance, which prevents intermixture, but offers no obstacle to the transmission of galvanic action. Two principal objects are accomplished by this arrangement of the constituent parts of the battery; first, the removal out of the circuit of the oxide of zinc, the deposit of which gradually reduces, and at length suspends, the action of the ordinary battery; and secondly, the absorption of the hydrogen evolved upon the surface of the copper, without the precipitation of any substance tending to counteract the voltaic action of that surface.

The advantages likely to arise to science from the invention of the constant voltaic battery are numerous and important. Mr. Daniell has shown how it may be made to supply a measure of chemical affinity, and has applied it with effect in the investigation of the influence of changes of temperature on voltaic action. The construction of a constant battery of large dimensions, which he has recently completed, has already opened new views of the possible application to economical purposes of the powers of voltaic electricity, an agent of which the influence appears to be so energetic and so widely diffused throughout nature.

The Council have adjudged one of the Royal Medals, in conformity with the announcement made in 1834, to Mr. Whewell, for his series of Researches on the subject of the Tides, which have been published in our Transactions during the last three years.

Mr. Whewell's researches have been chiefly directed to the three following points: first, the motion of the tide-wave at different points

of the ocean; secondly, the comparison of the *observed* laws at certain places with the *theory*; and lastly, the laws of the diurnal inequality of the tide.

It is to Mr. Lubbock that we are indebted for the first accurate comparison of the theory of the tides as given by Bernouilli in his treatise *Du flux et reflux de la mer*, with the results of observation as deduced from a period of nineteen years in the port of London. In this memoir, which was published in our Transactions for 1831, there was given a most elaborate discussion by Mr. Dessiou, under Mr. Lubbock's directions, of more than 13,000 observations, and the results were of great importance, not merely as furnishing the materials and the general rules for the construction of tide tables, but also for the general accordance which they exhibited with the equilibrium theory of Bernouilli, particularly with respect to the *semimenstrual inequality*. This agreement was the more important, as affording the indication of the real existence of a physical connection between the theory and observation, and as consequently justifying such a further examination of its consequences as might lead to the discovery or suggestion of such modifications of it as would lead to its general accordance with the laws of all the facts observed.

In a subsequent discussion of the tides of Liverpool, published in our Transactions in 1835 and 1836, Mr. Lubbock showed, as had partly indeed been suggested by Mr. Whewell in his papers on the empirical laws of the tides of London and Liverpool, that by referring the tide, not to the lunar transit immediately preceding, but to an anterior lunar transit, one, two, or more days before, that the formulæ furnished by the equilibrium theory would be brought into almost perfect accordance with the observed inequalities in the heights and times of the tides which are due to the changes in the moon's parallax. This was a most important step in the connexion between theory and observation, and has been found to apply, to a considerable extent, to all the periodical inequalities of the tides, though very different epochs are required for different inequalities. Thus Mr. Whewell has shown that the diurnal inequality in the heights of high and low water, which is due to the change in the moon's declination, would require to be referred to the lunar transit four days preceding.

But though the formulæ furnished by theory can be thus adjusted to represent generally the results of observation for any assigned station, yet our theory is quite incompetent to assign the physico-mathematical grounds upon which such adjustments are made: the complete solution of such a problem would probably require a knowledge of the laws of hydrodynamics much beyond that which we now possess.

The first memoir which was published by Mr. Whewell was an "Essay towards a first approximation to a map of cotidal lines," and appeared in our Transactions for 1833.

By *cotidal* lines, Mr. Whewell means those lines which may be drawn through all those points of the ocean which have high-water at the same moment of absolute time.

By analysing the movements of the tides as determined by the most simple considerations of the laws of fluid motion in open seas and in channels, and by explaining the circumstances of their convergence or divergence, their interference with each other, their retardation in shallow water, and their consequent tendency to sweep round the coasts and to approach them almost perpendicularly; and further, by discussing very carefully all the materials which nautical surveys and books of navigation could furnish him, Mr. Whewell was enabled to construct a map, which not only represented the general circumstances of the tides of the coasts of Great Britain, but likewise the movement of the great tidal wave, on the coasts of Europe, in the Atlantic Ocean, in the Indian seas, and on the coasts of New Zealand.

It was with a view to correct this first approximation to a map of cotidal lines that Mr. Whewell procured a very extensive series of observations to be made on the coasts of Great Britain and Ireland at 547 stations of the Coast Guard for an entire fortnight in June, 1834. These observations were repeated in June, 1835, and were accompanied by simultaneous observations made by the great maritime powers of Europe and North America, at the request of the Government of this country, at various stations on their coasts. The immense mass of observations, thus furnished, were reduced, under Mr. Whewell's directions, at the expense of the Admiralty, and some of the results, which are extremely important and interesting, have been communicated by him to the Royal Society in two Memoirs in our Transactions for 1835 and 1836. The last of these Memoirs was accompanied by a second map of the cotidal lines of the coasts of Europe, accompanied also by indications, effected by a peculiar notation, of the total range, in yards, of the tides at the different stations at which observations had been made.

Many very remarkable conclusions with respect to the motion of the tide-wave have resulted from these observations; amongst others may be mentioned the rotatory motion of the tide-wave which enters the German Ocean between the Orkneys and Norway, sends a southerly detachment along the coasts of Great Britain, which is reflected from the projecting coast of Norfolk upon the north coast of Germany, and meets the main wave again on the coast of Denmark.

It is impossible in the course of a very brief abstract like the present to notice all Mr. Whewell's researches in detail. His second great object was to compare the observed laws of the tides with the theory, or to propose such modifications of the forms of the theory as would reconcile it with the observations.

The interest which attaches to such investigations, which is so great during the progress of the structure which is to be raised upon them, ceases in many cases when the fabric is completed: a remark which is applicable to many of the most important researches and discoveries in philosophy, where we are accustomed to regard the last form only in which the theory is compared with the facts which are observed, and to forget or to neglect the series of

laborious investigations which have led to its establishment, but which are no longer necessary for its explanation or proof. This observation may be applied, in some degree, to his very ingenious Memoir "On the Empirical Laws of the Port of London", in which he attempts to deduce from observation and from very simple general considerations, the character of the formulæ for determining the establishment, the semimenstrual inequality, the corrections for lunar and solar parallax and declination, both as affecting the times and the height of high water. Similar observations may be extended to his papers on the "Empirical Laws of the Tides of the Port of Liverpool," and also on the "solar inequality and diurnal inequality" of the tides at the same place, which are full of valuable suggestions which the subsequent investigations of Mr. Lubbock have, in some cases, very remarkably confirmed and extended.

The last of the series of researches of Mr. Whewell relate to the diurnal inequality of the height of the tide, which the discussion of the tides at Liverpool had exhibited, though under circumstances much less striking than those which characterize its appearance in other places. The first of his memoirs on this subject relates to the diurnal inequality at Plymouth and Sincapore, at the last of which places its magnitude is very remarkable, making a difference of not less than six feet in the height of morning and evening tide, and quite sufficient to obliterate, under certain circumstances, one of the semidiurnal tides, and explaining certain phænomena in the tides which have been considered as cases of interference. Mr. Whewell was led, from certain remarkable changes in the epoch of this phænomenon, which seemed to be deducible from the observations at Bristol, Liverpool and Leith, to suspect that its progress along the coasts of Europe and Great Britain was retarded according to some regular law. His subsequent discussion, however, of the simultaneous observations made in June, 1835, with an especial view to this inequality, showed that the differences of diurnal inequality were governed by local causes, and consequently negatived altogether the hypothesis of its progressive propagation according to a law distinct from that of the other inequalities of the tides.

The preceding abstract of Mr. Whewell's Researches on the Tides is necessarily very brief and imperfect, and little calculated to convey to the minds of those who have not read his very extensive series of memoirs an adequate notion of the amount of labour and of thought which the discussion of such extensive series of observations must have required.

The importance of the results which have been obtained by him and Mr. Lubbock, may be best estimated by the rapid advancement which has been made in our knowledge of the laws which regulate the movements of the tides during the last six years, and which is entirely owing to their joint labours. Theory, though little cultivated and little known, was then in advance of observation: tide tables were constructed by unpublished rules, which formed a profitable possession to those to whom the secret was known: and the distinctive characters of the tides in the different ports of this king-

dom, that of Liverpool perhaps excepted, were confined to the experience and tact of those who were accustomed to use them; but how different is the case at present! The rules for the construction of tide tables are not only public property, but are based upon the most extensive observations: laws, whose existence was hardly suspected, are now distinctly laid down: the progress of the waves in the most frequented parts of the ocean is beginning to be accurately developed: theory, which was formerly in advance of observation, though greatly improved in those parts of it which do not involve the hydrodynamical laws of the ocean, is now greatly behind it; and such a basis of facts has been laid down as may enable the mathematician to commence such a series of investigations, as may terminate in enabling another Laplace to give to the theory of the tides a form which may rival, in the certainty of its predictions, the almost perfect theories of physical astronomy.

On the motion of Mr. Davies Gilbert, the thanks of the Society were voted to His Royal Highness the President for his excellent Address, accompanied with a request that His Royal Highness would allow it to be printed.

The Statutes relating to the election of Council and Officers were then read by the Secretary; and Joseph Smith and Richard Horsman Solly, Esqrs., being nominated by the Chairman, with the approbation of the Meeting, Scrutators to assist the Secretaries in examining the balloting lists, the votes of the Fellows present were collected.

The ballot being taken, the Scrutators reported the following as the result:

President.—His Royal Highness the Duke of Sussex, K.G.

Treasurer.—Francis Baily, Esq.

Secretaries.—Peter Mark Roget, M.D.; Samuel Hunter Christie, Esq., MA.

Foreign Secretary.—William Henry Smyth, Capt. R.N.

Other Members of the Council.—John Bostock, M.D.; The Earl of Burlington; John George Children, Esq.; John Frederick Daniell, Esq.; Sir Philip Grey Egerton, Bart.; Davies Gilbert, Esq., D.C.L.; Charles Konig, Esq.; The Marquis of Northampton; Rev. George Peacock, M.A.; William Hasledine Pepys, Esq.; Stephen Peter Rigaud, Esq., M.A; John Forbes Royle, M.D.; Benjamin Travers, Esq.; James Walker, Esq; Charles Wheatstone, Esq.; Rev. William Whewell, M.A.

The thanks of the Society were then voted to the Scrutators, for their trouble in assisting at the Election.

The following is the statement with respect to the Receipts and Payments of the Society during the preceding year, which was laid on the table by the Treasurer.

Statement of the Receipts and Payments of the Royal Society between Nov. 29, 1836, and Nov. 29, 1837.

RECEIPTS.

	£.	s.	d.	£.	s.	d.
Balance in the hands of the Treasurer at the last Audit ..				533	4	11
33 Weekly Contributions, at one shilling				85	16	0
109 Quarterly Contributions, at £1				445	10	0
23 Admission Fees				230	0	0
7 Compositions for Annual Payments at £60.				420	0	0
Rents :—						
One year's rent of estate at Mablethorpe: due at Michaelmas, (less the expenses of defending the Tythe suit, £16 13 0)	90	7	0			
One year's rent of lands at Acton: due at Michaelmas	60	0	0			
One year's fee-farm rent of lands in Sussex; land-tax deducted: due at Michaelmas ..	19	4	0			
One fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's will: due at Midsummer.................	3	0	0			
				172	11	0
Dividends on Stock :—						
One year's dividend on £14,000 Reduced 3 per cent. Annuities	420	0	0			
One year's dividend on £200 Consols	6	0	0			
Dividend on £3452. 1. 1 Consols, the produce of the sale of the premises in Coleman-street..........................	103	11	2			
Donation Fund.						
One year's dividend on £3820. 19. 3 Consols	114	12	6			
Rumford Fund.						
One year's dividend on £2161. 0. 10 Consols	64	16	8			
Fairchild Fund.						
One year's dividend on £100 New South Sea Annuities	3	0	0			
				712	0	4
Miscellaneous Receipts :—						
Sale of Philosophical Transactions........	278	7	2			
Abstracts of Papers....................	7	18	6			
Index to the volumes..................	1	8	6			
				287	14	2
Total Receipts				£2886	16	5

PAYMENTS.

	£.	s.	d.	£.	s.	d.
Bakerian Lecture.—William H. Fox Talbot, Esq., for the Bakerian Lecture				4	0	0
Donation Fund. Newman, for Barometer, &c.				32	19	3
———— Cost of £329. 0*s*. 9*d*. Consols				300	4	9
British Museum Fund. Baillière for Books				111	2	6
Salaries:—				448	6	6
Dr. Roget, one year, as Secretary	105	0	0			
J. G. Children, Esq., one year, as Secretary	105	0	0			
Ditto for Index to Phil. Trans.	5	5	0			
C. Konig, Esq., one year, as Foreign Secretary	20	0	0			
Mr. Roberton, one year, as Assistant-Secretary	160	0	0			
Mr. W. E. Shuckard, one year as Librarian	50	0	0			
Mr. Holtzer, one year, as Porter	30	0	0			
Ditto, for extra Porterage	10	0	0			
				485	5	0
Fire Insurance, on the Society's Property				22	11	6
Mrs. Coppard: Gratuity				10	0	0
Gratuity to the Infant School at Acton				10	0	0
Bills:—						
Taylor: On account of printing the Catalogue				200	0	0
Ditto: Printing the Phil. Trans., 1836, part 2, and 1837, part 1; Proceedings, Nos. 26—29, and Index; Circulars, Lists of Fellows, Ballot-lists, Statement of Payments, and Minutes of Council; &c. &c.	590	19	11			
Bowles and Gardiner: For Paper for the Phil. Trans., 1837, parts 1 and 2	153	4	0			
Basire: For Engraving and Copper-plate Printing for Phil. Trans., 1837, parts 1 and 2, &c.	328	2	3			
Gyde: Sewing and Boarding 1079 Parts of Phil. Trans., and 250 Abstracts	63	16	8			
				1136	2	10
Packer: For Engrossing the Address to Queen	5	11	0			
Chappell: For Stationery	13	1	0			
Carried forward	18	12	0	2312	5	10

	£.	s.	d.	£.	s.	d.
Brought forward	18	12	0	2312	5	10
Saunderson:						
For Shipping Expenses	2	14	11			
Brecknell and Turner:						
For Wax Lights, Candles, and Lamp Oil	36	16	0			
Skelton:						
For Cleaning Chandeliers, and repairing Lamps, Locks, &c.	7	7	7			
Cubitt:						
For Repairing Windows, Carpets, &c.	7	1	1			
Cobbett and Son:						
For Window-cleaning and Glazing	2	14	0			
Gwillim:						
For Brushes, Fire wood, &c.	2	17	9			
Exchequer Fee for paying dividend		13	0			
Caldecott:						
For Furniture	28	9	2			
Wood:						
For Coals	35	19	0			
Murray:						
For taking Meteorological Observations	7	0	0			
				150	4	6
Taxes and Parish Rates:						
Land Tax	1	17	6			
Ditto Arrears (2 years)	6	5	0			
Poor Rate	6	0	0			
Church Rate		15	0			
Rector's Rate		7	6			
Sewers Rate	3	0	0			
				18	5	0
Petty Charges:						
L' Institut	2	5	0			
Silliman's Journal	1	2	6			
Attending Clocks	1	11	6			
Postage and Carriage	9	15	0			
Extra Messenger	1	3	6			
Expenses on Foreign Packets, &c.	6	18	11			
Stamps	2	12	6			
Charwoman's Wages	27	6	0			
Extra Charwoman's work	3	7	6			
Miscellaneous expenses	12	15	0			
				68	17	5
Total Payments				£2549	12	9
Balance in the hands of the Treasurer				337	3	8
				£2886	16	5

FRANCIS BAILY, *Treasurer*.

November 29*th*, 1837.

The Balances in hand, now belonging to the several trusts, are as under: viz:—

	£.	s.	d.
British Museum Fund	**245**	**3**	**4**
Donation Fund	**109**	**6**	**4**
Rumford Fund	**194**	**10**	**0**

The following table shows the progress and present state of the Society, with respect to the number of Fellows:

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2. 12. Annually.	Paying £4 Annually.	Total.
November, 1836	10	46	591	37	109	**793**
Since elected	1	4	4	......	22	**31**
Since deceased, &c.	−1	−2	−24	−3	−1	**−31**
Since compounded	......	......	3	......	−3	....
Defaulters	......	......	......	−2	−3	**−5**
November, 1837	10	48	574	32	124	**788**

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1837—1838. No. 31.

December 7, 1837.

FRANCIS BAILY, Esq., Vice-President and Treasurer, in the Chair.

No paper was read.

December 14, 1837.

JOHN GEORGE CHILDREN, Esq., Vice-President, in the Chair.

The reading of a paper, entitled "On low Fogs and stationary Clouds." By William Kelly, M.D. Communicated by Captain Beaufort, R.N., F.R.S., &c., was resumed and concluded.

The object of the present paper is to point out the circumstances which influence the formation of low fogs, and to show what analogy exists between the causes that produce them and those that occasion certain forms of clouds, which may be considered as differing from fogs only in position. Having been attached for several years to the naval party employed in the survey of the gulf and river of St. Lawrence, the author had ample opportunities of observing the phenomena in question. He concludes that the fogs described occur chiefly when the air is nearly saturated with moisture, and when at the same time the temperature of the water on which they rest either exceeds that of the air, or is considerably below it. These fogs are generally very dense, often limiting the sphere of vision to a few fathoms; but seldom extend to any considerable height. They do not often cover the land to any distance from the shore; and the tops of the hills, close to the water's edge, are clear, while the bases, or sides, are enveloped in the mist.

The following papers were then read:—

"On the Colours of Mixed Plates." By Sir David Brewster, K.G.H., F.R.S., &c.

In the prosecution of his optical inquiries, the author was induced to study the phenomena of mixed plates, (originally discovered by Dr. Young, and described by him in the Philosophical Transactions for 1802,) as he had observed similar appearances in various mineral bodies under analogous circumstances, to which he had been led to

ascribe an origin different from that assigned by Dr. Young. In order to obtain a more distinct view of these colours, Sir David Brewster employed, instead of the substances used by Dr. Young, the white of an egg, beat up into froth, and pressed into a thin film between plates of glass. From observations of the colours exhibited by plates so prepared, and also by the edge of a thin film of nacrite in contact with copaivi balsam, the author deduces the conclusion, that all these phenomena, as well as those often seen in certain specimens of mica through which titanium is disseminated, and also in sulphate of lime, are cases of diffraction, where the light is obstructed by the edges of very thin transparent plates placed in a medium of different refractive power. If the plate were opake, the fringes produced would be of the same kind as those often noticed, and which are explained on the principle of interference; but, owing to the transparency of the plate, fringes are produced within its shadow; and, owing to the thinness of the plate, the light transmitted through it is retarded, and, interfering with the partial waves which pass through the plate, and with those which pass beyond the diffracting edge with undiminished velocity, modify the usual system of fringes in the manner described by the author in the present paper.

"Of such Ellipsoids, consisting of homogeneous Matter, as are capable of having the Resultant of the Attraction of the Mass upon a Particle in the Surface, and a Centrifugal Force caused by revolving about one of the Axes, made perpendicular to the Surface." By James Ivory, K.H., M.A., F.R.S. L. and Ed., Inst. Reg. Sc., Paris, Corresp. et Reg. Sc. Gotting. Corresp.

Lagrange, who has considered the problem of the attractions of homogeneous ellipsoids in all its generality, and has given the true equations from which its solution must be derived, inferred from them that a homogeneous planet cannot be in equilibrium unless it has a figure of revolution. But M. Jacobi has proved that an equilibrium is possible in some ellipsoids of which the three axes are unequal and have a certain relation to one another. His transcendental equations, however, although adapted to numerical computation on particular suppositions, still leave the most interesting points of the problem unexplored.

The author of the present paper points out the following property as being characteristic of all spheroids with which an equilibrium is possible on the supposition of a centrifugal force. From any point in the surface of the ellipsoid draw a perpendicular to the least axis, and likewise a line at right angles to the surface: if the plane passing through these two lines contain the resultant of the attractions of all the particles of the spheroid upon the point in the surface, the equilibrium will be possible, otherwise it will not. For the resultant of the centrifugal force and the attraction of the mass must be a force perpendicular to the surface of the ellipsoid, which requires that the directions of the three forces shall be contained in

one plane. This determination obviously comprehends all spheroids of revolution; but, on account of the complicated nature of the attractive force, it is difficult to deduce from it whether an equilibrium be possible or not in spheroids of three unequal axes, a problem which is unconnected with the physical conditions of equilibrium, and which is a purely geometrical question respecting a property of certain ellipsoids.

The author then enters into an analytical investigation, from which he deduces the fundamental equation

$$B - \frac{A}{1 + \lambda^2} = C - \frac{A}{1 + \lambda'^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1.)$$

the three axes of the ellipsoid being

$$k, \quad k\sqrt{(1 + \lambda)}, \quad k\sqrt{(1 + \lambda'^2)},$$

and A, B, C, constants, afterwards expressed by certain definite integrals. He then remarks that every ellipsoid which verifies this formula is capable of an equilibrium when it is made to revolve with a proper angular velocity about the least axis; for, in this case, the centrifugal force will be represented in quantity and direction by a line such that the resultant of this force and the whole attraction of the ellipsoid upon a point in the surface will be perpendicular to the surface. Lagrange had concluded that the equation (1), which results immediately from his investigations, admits of solution only in spheroids of revolution, that is when $\lambda = \lambda'$ and $B = C$; but by expressing the functions A, B, C in elliptic integrals, M. Jacobi has found that the equation may be solved when the three axes have a particular relation to one another. In order to ascertain the precise limits within which this extension of the problem is possible, and to determine the ellipsoid when the centrifugal force is given, the author has recourse to the equations of Lagrange, which contain all the necessary conditions, and he deduces the equations

$$f = B - \frac{A}{1 + \lambda^2}, \quad f = C - \frac{A}{1 + \lambda'^2}, \quad . \quad . \quad . \quad (2.)$$

where f represents the intensity of the centrifugal force at the distance equal to unity from the axis of rotation, and remarks that these equations coincide with the equations of Lagrange. Substituting for A, B, C certain definite integrals given in the *Mécanique Celeste,* he deduces three equations expressing the value of g, the ratio of the intensity of the centrifugal to that of the attractive force, one of these being expressed in terms of the density and the other two in the form of definite integrals; and then remarks that "these equations comprehend all ellipsoids that are susceptible of equilibrium on the supposition of a centrifugal force."

He then applies these equations to the more simple case of the spheroid of revolution, where $\lambda = \lambda' = l$, and determines the value of l

$$l = 2{\cdot}5293,$$

and the corresponding maximum value of $g = 0{\cdot}3370$, and remarks that, "with respect to spheroids of revolution, it thus appears that an equilibrium is impossible when g, or its value in terms of the density, is greater than 0·3370. In the extreme case, when g is equal to 0·3370, there is only one form of equilibrium, the axes of the spheroid being

$$k \text{ and } k\,\sqrt{\{1 + (2{\cdot}5293)^2\}} \text{ or } 2{\cdot}7197\,k\,;$$

but when g is less than 0·3370 there are two different forms of equilibrium, the equatorial radius of the one being less, and of the other greater than 2·7197 k, k being the semi-axis of rotation.

The number of the forms of equilibrium in spheroids of revolution, he remarks, is purely a mathematical deduction from the expression of the ratio of the centrifugal to the attractive forces; and as this has been known since the time of Maclaurin, the discussion of it was all that was wanted for perfecting this part of the theory.

Returning to the general equations of the problem, the author deduces the equations

$$g = \frac{d\,\phi}{d\,p}\,p$$

$$o = \frac{d\,\phi}{\tau\,d\,\tau},$$

where ϕ is a definite integral, such that

$$g = \frac{d\,\phi}{d\,\lambda}\,.\,\lambda,\quad g = \frac{d\,\phi'}{d\,\lambda'}.$$

$$p = \lambda\,\lambda' \text{ and } \tau^2 = (\lambda - \lambda')^2,$$

which equations apply exclusively to ellipsoids with three unequal axes, and solve the problem with regard to that class. From these he derives another equation, which he states is no other than a transformation of his first fundamental equation, and is equivalent to other transformations of the same equation found by M. Jacobi and M. Liouville.

He also remarks that a limitation of one of the constants, which the verification of this formula requires, agrees with the limitation of M. Jacobi; and further, that the relations which may subsist between the constants proves that there does exist an infinite number of ellipsoids not of revolution, which are susceptible of an equilibrium.

After determining the corresponding limits of these relations of the constants, p being contained between the limits 1·9414 and 1, while τ^2 increases from zero to infinity, he remarks that an elliptical spheroid formed of a homogeneous fluid can be in equilibrium by the action of a centrifugal force only when it revolves about the [illegible] axis.

He next deduces the general value of g (the rati[illegible] and thence its value in one extreme case, when [illegible]

λ and λ' are equal, and remarks that this is no other than the determination of g in a spheroid of revolution having its axes equal to

$$k \text{ and } k \sqrt{2{\cdot}9414} = k \times 1{\cdot}7150.$$

In the other extreme case, when τ^2 is infinitely great, g is zero,

From this investigation the conclusion is arrived at, that for every given value of τ^2 there is only one value of p, and only one ellipsoid; and that to every such ellipsoid there is an appropriate value of g: and, further, that for every possible value of g there will be only one value of τ^2, and consequently only one ellipsoid susceptible of an equilibrium.

Also the reading of a paper, entitled, "Experimental Researches in Electricity." Eleventh series. By M. Faraday, Esq., D.C.L., F.R.S., Fullerian Professor of Chemistry at the Royal Institution, was commenced.

December 21, 1837.

FRANCIS BAILY, Esq., Vice-President and Treasurer, in the Chair.

The reading of Mr. Faraday's eleventh series of Experimental Researches in Electricity was resumed, but not concluded.

The Society then adjourned over the Christmas vacation to meet again on the 11th of January next.

January 11, 1838.

JOHN GEORGE CHILDREN, Esq., Vice-President, in the [illegible]

The ballot for Bryan Donkin, Esq., was postponed in [illegible] of the number of Fellows required by the Statutes not [illegible]

The reading of a paper, entitled "Experimental [illegible] Electricity," Eleventh Series, by Michael Faraday, [illegible] F.R.S., Fullerian Professor of Chemistry at the [illegible] &c., was resumed and concluded.

The object of this paper is to establish two [illegible] lating to the theory of electricity, which [illegible] portance; first, that induction is in all cases [illegible] of contiguous particles; and secondly, that [illegible] different inductive capacities.

The class of phænomena usually [illegible] *duction* are reducible to a general fact, [illegible] recognise in all electrical phænomena [illegible] the operation of a principle having all [illegible] [illegible] fundamental law [illegible] by which [illegible] in the [illegible]

of many dissimilar phænomena to one single comprehensive law. As the whole effect upon the electrolyte appeared to be an action of the particles when thrown into a peculiar polarized state, he was led to suspect that common induction itself is in all cases an *action of contiguous particles*, and that electrical action at a distance, which is what is meant by the term *induction*, never occurs except through the intermediate agency of intervening matter. He considered that a test of the correctness of his views might be obtained by tracing the course of inductive action; for if it were found to be exerted in curved lines it would naturally indicate the action of contiguous particles, and would scarcely be compatible with action at a distance. Moreover, if induction be an action of contiguous particles, and likewise the first step in electrolyzation, there seemed reason to expect some particular relation of this action to the different kinds of matter through which it is exerted; that is, something equivalent to a specific electric induction for different bodies; and the existence of such specific powers would be an irrefragable proof of the dependence of induction on the intervening particles. The failure of all attempts to produce an absolute charge of electricity of one species alone, independent of the other, first suggested to the author the notion that induction is the result of actions among the individual and contiguous particles of matter, having both forces developed to an extent exactly equal in each particle.

The author describes various experiments, with the view of showing that no case ever occurs in which an absolute charge of one species of electricity can be given. His first experiments were conducted on a very large scale: an insulated cube, twelve feet in the side, consisting of a wooden frame, with wire net-work, every part of which was brought into good metallic contact by bands of tin foil, had a glass tube, containing a wire in connexion with a large electrical machine, passed through its side, so that about four feet of the tube entered within the cube and two feet remained without; but it was found impossible in any way to charge the air within this apparatus with the least portion of either electricity.

For investigating the question whether induction is an action of contiguous particles, the author employed, as an electrometer, the torsion balance of Coulomb with certain alterations and additions; and for deciding that of specific inductive capacity, a new apparatus, constructed for that express purpose. This apparatus consisted of two hollow brass spheres, of very unequal diameters, the smaller placed within the larger, and concentric with it; the interval between the two being the space through which the induction was to be effected. The apparatus had a tube in the lower part, furnished with a stop-cock, by means of which it might be connected with an air-pump or filled with any required gas. In place of the lower hemispherical shell of air, occupying the interval between the two spheres, any solid dielectric, of the same form, such as shell-lac, glass, or sulphur, might be substituted. Two of these instruments, precisely similar in every respect, were constructed, and the author ascertained that the inductive power was the same in both, by alter-

nately charging each and dividing the charge with the other, and finding that, in all cases, the charge remaining in the one, and also that received by the other, was very nearly half the original charge.

The experiments on which the author principally relies in support of the correctness of his views relative to induction being exerted in curved lines, are the following: a brass ball being laid on the top of an excited cylinder of shell-lac placed vertically, the charge which a carrier ball received when brought to different points near to the brass sphere was measured by means of the electrometer; and it was inferred, from the character of the electricity, that the charge was one by induction, and from its measure, that it proceeded in curved lines. By substituting for the brass sphere a disc of metal above the shell-lac cylinder, it was found that when the carrier ball was brought near to the middle of the disc no charge was communicated, although a sensible one was obtained at the edge of the disc, and also at a point above its centre, farther removed from the excited cylinder. Corresponding and very striking results were obtained when a brass hemisphere was placed on the top of the cylinder of lac. The charge communicated at the centre of the hemisphere was only one-third of that obtained at the edge of its periphery; but by taking it at a point at some height above the centre, and consequently much farther removed from the inducing cause, the charge was nearly equal to that of the periphery. Here, the author remarks, the induction fairly turned a corner, exhibiting both the curved lines or courses of its action, when disturbed from their rectilineal form by the shape, position and condition of the metallic hemisphere; and also a lateral tension, so to speak, of these lines on one another; all depending on induction being an action of the contiguous particles of the dielectric thrown into a state of polarity and tension, and mutually related by their forces in all directions. In the foregoing experiments the dielectric was air; but they were afterwards varied by substituting a fluid, as oil of turpentine, and likewise a few solid dielectrics, namely, shell-lac, sulphur, carbonate and borate of lead, flint-glass, and spermaceti, and with these, corresponding results were obtained. These results, the author considers, cannot but be admitted as arguments against the received theory of induction, and in favour of that which he has put forth.

In the course of these experimental researches, some effects due to conduction, which had not been anticipated, and which were similar to the residual charge in the Leyden jar, had been obtained with such bodies as glass, lac, sulphur, &c. If the inductive apparatus, fitted with a hemispherical cup of shell-lac, after having remained charged for fifteen or twenty minutes, was suddenly and perfectly discharged, and then left to itself, it would gradually recover a very sensible charge; the electricity which thus returned from an apparently latent to a sensible state being always of the same kind as that given by the charge. This return charge is attributed to an actual penetration, by conduction, of the charge to some distance within the dielectric at each of its two surfaces, and several experi-

ments are adduced in support of this view. With shell-lac and spermaceti the return charge was considerable; with glass and sulphur it was much less; but with air, no decided effect of the kind could be obtained. As this was an effect which might interfere with the results, in the method the author adopted for deciding the question of specific inductive capacity, and as time was requisite for this penetration of the charge, its influence on these results was guarded against by allowing, between the successive operations, as little time as possible for this peculiar action to arise.

The author thus states the question of specific inductive capacity which he had proposed to investigate:—Suppose A an electrified plate of metal suspended in the air, and B and C two exactly similar plates, placed parallel to and on each side of A, at equal distances, and uninsulated; A will then induce equally towards B and C. If in this position of the plates, some other dielectric than air, as shell-lac, be introduced between A and C, will the induction between them remain the same; or will the relation of C and B to A be altered by the difference of the dielectrics interposed between them?

The experiment of Coulomb, from which it appeared that a wire surrounded by shell-lac took exactly the same quantity of electricity from a charged body, as the same body took in air, seemed to the author to be no proof of the truth of the assumption, that, under such variation of the circumstances as he had supposed, no change would occur. Entertaining these doubts as to the conclusions deducible from Coulomb's result, he had the apparatus previously described constructed, as being well adapted for this investigation. After rejecting glass, resin, wax, naphtha, oil of turpentine, and other substances, as unfit for the purpose in view, he chose shell-lac as the substance best calculated to serve as an experimental test of the question.

For the purpose of comparing the inductive capacities of shell-lac and air, a hemispherical cup of shell-lac was introduced into the lower hemisphere of one of the inductive apparatus, so as to nearly fill the lower half of the space between the two spheres; and their charges were divided in the manner already described; each apparatus being used in turn to receive the first charge, before its division with the other. As the two instruments were known to have equal inductive powers when air was contained in both, any deficiencies resulting from the introduction of the shell-lac would show a peculiar action in it, and, if unequivocally referable to a specific inductive influence, would establish the point in question.

The air apparatus being charged, and its disposable charge being 290°, this charge was divided between the two. After the division the charge in the lac apparatus was 113°, and in the air apparatus 114°. From this it appears, that whilst by the division the induction through the air lost 176°, that through lac gained only 113°. Assuming that this difference depends entirely on the greater facility possessed by shell-lac of allowing or causing inductive action through its substance than that possessed by air, then the capacity for electric induction would be inversely as the respective loss and gain; and as-

suming the capacity of the air apparatus as unity, that of the shell-lac apparatus would be $\frac{176}{113}$ or 1·55.

When the shell-lac apparatus was first charged, and then the charge divided with the air apparatus, it appeared that the lac apparatus, in communicating a charge of 118°, only lost a charge of 86°. This result gives 1·37 as the capacity of the lac apparatus.

Both these results, the author considers, require a correction; the former being in excess, the latter in defect. Applying this correction, they become 1·50 and 1·47. From a mean of these and several similar experiments, it is inferred that the inductive capacity of the apparatus having the hemisphere of lac is to that with air as 1·50 to 1.

As the lac only occupied one half of the apparatus containing it, the other half being filled with air, it would follow from the foregoing result, that the inductive capacity of shell-lac is to that of air as 2 to 1.

From all these experiments and from the constancy of their results the author deems the conclusion irresistible, that shell-lac does exhibit a case of *specific inductive capacity.*

Similar experiments with flint-glass gave its capacity 1·76 times that of air. Using in like manner a hemisphere of sulphur, it appeared that the inductive capacity of that substance was rather above 2·24 times that of air, and the author considers this result with sulphur as one of the most unexceptionable.

With liquids, as oil of turpentine and naphtha, although the results are not inconsistent with the belief, that these liquids have a greater specific inductive capacity than air, yet the author does not consider the proofs as perfectly conclusive.

A most interesting class of substances, in relation to specific inductive capacity, the gases or aeriform bodies, next came under the author's review.

With atmospheric air, and likewise with pure oxygen, change of density was found to occasion no change in the inductive capacity. Nor was any change produced, either by an increase of temperature or by a variation in the hygrometric state.

The details are then given of a very elaborate series of experiments with atmospheric air, oxygen, hydrogen, nitrogen, muriatic acid, carbonic acid, sulphurous acid, sulphuretted hydrogen, and other gases, undertaken with the view of comparing them one with another under a great variety of modifications. Notwithstanding the striking contrasts of all kinds which these gases present, of property, of density, whether simple or compound, anious or cations, of high or low pressure, hot or cold, not the least difference in their capacity to favour or admit electrical induction through them could be perceived. Considering the point established, that in all these gases induction takes place by an action of contiguous particles, this is the more important, and adds one to the many striking relations which hold among bodies having the gaseous form.

In conclusion, the author remarks, that induction appears to be essentially an action of contiguous particles, through the intermediation of which the electric force originating or appearing at a certain place, is propagated to or sustained at a distance, appearing there as a force of the same kind and exactly equal in amount, but opposite in its direction and tendencies. Induction requires no sensible thickness in the conductors which may be used to limit its extent, for an uninsulated leaf of gold may be made very highly positive on one surface, and as highly negative on the other, without the least interference of the two states, as long as the induction continues. But with regard to dielectrics, or insulating media, the results are very different; for their thickness has an immediate and important influence on the degree of induction. As to their quality, though all gases and vapours are alike, whatever be their state, amongst solid bodies, and between them and gases, there are differences which prove the existence of specific inductive capacities.

The author also refers to a transverse force with which the direct inductive force is accompanied. The experimental proof of the existence of such a force, in all cases of induction, is, from its bearing on the phænomena of electro-magnetism and magneto-electricity, of the highest importance; and we cannot but look forward with the greatest interest to the promised communication in which these and other phænomena relating to this subject will be reviewed.

January 18, 1838.

FRANCIS BAILY, Esq., Vice-President and Treasurer, in the Chair.

Bryan Donkin, Esq.; Sir John Jacob Hansler; the Rev. George Henry Sacheverell Johnson, M.A.; and George Richardson Porter, Esq., were severally elected Fellows of the Society.

"On the Variation of a Triple Integral." By Richard Abbott, Esq. F.R.A.S. Communicated by Benjamin Gompertz, Esq., F.R.S.

In the calculus of variations, the discovery of which has immortalized the name of Lagrange, that illustrious mathematician, by differentiating the function with respect to a new variable which enters into it, reduced the general problem of indeterminate maxima and minima to the solution of an equation depending on the variation of the given integral, whether single or multiple, and whose differential coefficient contains any number of variables, or which even depends on other integrals. The author investigates, in the present memoir, the case in which the given function is a triple integral; its variation being composed of two distinct parts, namely, a triple integral and another part, the determination of which must be sought from the limits of the triple integral.

"Explanation of the Phænomena of Intermitting Springs." By

W. L. Wharton, Esq. Communicated by James F. W. Johnston, Esq., M.A., F.R.S. L. & Ed.

The author, considering the generally received explanation of intermitting springs, founded on the operation of a simple syphon, as being insufficient to account for the phænomena, inasmuch as the water which has risen above the lower side of the bend of the syphon will merely trickle down its longer leg, and be expended before it can fill the whole area of that part of the syphon, has proposed the following hypothesis for the solution of the difficulty. He conceives that the stream, while falling obliquely down the long leg of the syphon, is broken into drops, and carries along with it numerous air-bubbles, which, if the lower end of the tube have an abrupt bend upwards, will be impelled forwards, and escape at the open part; thus occasioning a rarefaction of the remaining air in the tube sufficient to ensure its full operation as a syphon. A model is described, which the author constructed for the purpose of illustrating and corroborating his views.

January 25, 1838.

FRANCIS BAILY, Esq., Vice-President and Treasurer, in the Chair.

Neil Arnott, M.D.; the Rev. William Cureton, M.A.; and Charles Lock Eastlake, Esq., were severally elected Fellows of the Society.

A paper was in part read, entitled, "Fourth Letter on Voltaic Combinations." Addressed to Michael Faraday, Esq., D.C.L., F.R.S., by John Frederic Daniell, Esq., F.R.S.

February 1, 1838.

FRANCIS BAILY, Esq., Vice-President and Treasurer, in the Chair.

The reading of a paper, entitled "Fourth Letter on Voltaic Combinations, with reference to the mutual relations of the generating and conducting surfaces;" addressed to Michael Faraday, Esq., D.C.L., F.R.S., &c. By John Frederic Daniell, Esq., F.R.S., Professor of Chemistry in King's College, London, was resumed and concluded.

In this communication the author describes a series of experiments, made for the purpose of determining the distribution of the voltaic force from its source in the generating metal, as indicated by the deposition of reduced copper in the constant battery; and, considering that the voltaic combination most perfect in theory would be one formed by a solid sphere, or point, of the generating metal, surrounded by a hollow sphere of the conducting metal, with an intervening liquid electrolyte, he constructed an apparatus making as near an approximation as possible to these conditions. It consisted of two hollow brass hemispheres, applied to each other by exterior

flanges, and rendered water-tight by an intervening collar of leather. In the centre of the hollow sphere thus formed, a ball of amalgamated zinc was suspended by a well-varnished copper wire, connected with one of the cups of a galvanometer, and was contained in a membranous bag holding the acid solution; the whole being introduced through a short tube in the top of the upper hemisphere, and the remaining space being filled with a saturated solution of sulphate of copper. The galvanic circuit was completed by wires establishing connexions between either hemisphere and the other cup of the galvanometer. For measuring the forces developed, sometimes the ordinary magnetic, but in the greater number of instances the calorific galvanometer of De la Rive was employed; the indications given by these instruments were noted, on the completion of the circuit, in various ways; and the deposition of copper in the hemispheres was examined after the apparatus had been in action for a certain number of hours.

The following are the conclusions which the author deduced from a series of experiments thus conducted:

1st. The force emanating from the active zinc centre diffuses itself over every part of the upper hemisphere, from which there is a good conducting passage for its circulation.

2nd. The same amount of force is maintained by either hemisphere indifferently; but when both conducting hemispheres are in metallic communication there is no increase of force.

3rd. Although the force is not increased, it spreads itself equally over the whole sphere.

4th. When one hemisphere is connected with the zinc centre by a short wire capable of affording circulation to the whole force, and the other hemisphere is connected by a long wire, through the galvanometer, with the same centre, the equal diffusion of the force over the whole sphere is maintained.

5th. There is no greater accumulation of precipitated copper about the point with which the conducting wires are brought into contact, and towards which the force diffused over the whole sphere must converge, than at any other point: proving that the force must diverge from the centre equally through the electrolyte, and can only have drawn towards the conducting wires in the conducting sphere itself. Other experiments showed that the force is but slightly increased by a great increase of the generating surface.

The author's attention was next directed to ascertaining the nature of the law according to which the force emanates from the zinc centre to the surrounding conducting sphere. With this view, a variety of experiments were made with the zinc in different positions in the interior of the sphere; and from these it appeared that, whatever may be its position, the whole force is the same. From these results it is inferred, that the force emanating from the zinc ball diffuses itself over the surrounding conducting sphere in obedience to the well-known law of radiant forces being in the inverse duplicate ratio of the distance.

Experiments of the same kind were likewise made with the pre-

vious combination inverted, that is, with a small copper ball in the interior of a large hollow sphere of zinc; and from these the author concludes that, in this case also, the law of radiation is maintained, although the force is reduced to one half of that obtained from the former combination.

In order to ascertain the effect of cutting off the lateral radiation from the zinc ball, it was placed in a glass tube, six inches long, within half an inch of the lower aperture, over which a piece of membrane was tied, and the tube plunged into the solution of copper contained in a brass hemisphere, so as to rest upon the bottom. The results obtained by this arrangement, as also those when the zinc ball was raised in the tube to the surface of the solution, showed that the action of the zinc ball had been propagated from the aperture of the glass tube, as from a centre, diverging from this in the solution.

The experiments next described appear to have an important bearing on a question of vital interest in the theory of electricity, which has been discussed by Mr. Faraday, in a paper recently read to this Society: viz., whether the forces emanating from a centre of electric action act, like other central forces, in straight lines; or whether they are propagated from particle to particle in the surrounding matter, and may, consequently, when obstacles interfere with their rectilinear propagation, exert their influence in curved lines. An elliptical plate of copper, one side of which was covered with lac varnish, was placed in an earthen pan, with the varnished side upwards, and covered to the depth of a few inches with the acid solution of copper. The zinc ball, placed in the tube half an inch from the diaphragm, was plunged just below the surface of the solution, and the circuit being completed, the galvanometer indicated an action nearly equal to that which had been previously observed when both sides of the copper had been exposed. The under side of the copper presented the appearance of a border of precipitated compact pink copper, varying from $1\frac{1}{4}$ to $\frac{7}{8}$ of an inch in width, and the remainder was covered with precipitated copper of a darker red colour, into which the border gradually passed; and similar results were obtained with a circular disc of copper, having one side varnished. It hence appears, that the under surface, which, by itself, is capable of sustaining from the ball in the centre of the solution an action nearly as great as the upper surface, when combined with the latter adds no more than about one-eighth part of its efficiency; and whereas, with the upper surface, the action varies in some inverse ratio of the distance of the generating from the conducting surface, with the under surface, there is a maximum point, on both sides of which it decreases: and this point is doubtless dependent on the angle at which the force which radiates from the ball meets the edge of the plate. The author having been led to the conclusion, that the force developed by voltaic combinations is subject to the law of radiant forces, had been utterly at a loss to understand how, upon this hypothesis, it could extend its influence to the side of a plate opposite to that to which it was directed in right lines; but having perused Mr. Faraday's "Eleventh series of experimental researches in

Electricity," all his own results appeared to fall in naturally with the general views therein explained. He considers, that the direction of the force through an electrolyte may be expressed in the very words employed in that paper to describe that of the direct inductive force in statical electricity, simply substituting the term *Electrolyte* for *Dielectric*, and the term *Current* for *Induction*.

Experiments are further described, in which the effects of various combinations of different generating and conducting surfaces, placed at different distances apart, were measured by the calorific galvanometer, from which the following conclusions are drawn:

1st. That the energy of the force is about sextupled by the absorption of the hydrogen at the conducting surface; except in the case of equal plates, when it is more than quadrupled.

2nd. That the effect of distance is much more decided in the instances where the amount of the circulating force is greater, than in the contrary cases.

3rd. That the amount of force put into circulation from a large surface of zinc towards a central ball of copper, is, as in former instances of similar combinations, about one half of that from the reverse arrangement.

4th. That a ball of zinc, exposing a surface of 3·14 square inches, placed over the centre of a plate of copper, exposing on its two sides a surface of 28 square inches, sustains an action of nearly the same amount as a plate of zinc, of the same dimensions as the copper, placed at the same distance.

In conclusion, the author remarks, that the principal circumstance which limits the power of an active point within a conducting sphere, in any given electrolyte, is the resistance of that electrolyte, which increases in a certain ratio to its depth or thickness; and this thickness may virtually be considered the same wherever the included point may be placed, but increases with the diameter of the sphere. In an insulated hemisphere, however, the approximation of the active point to the lower surface virtually decreases the thickness of the electrolyte, and consequently the force increases. In this respect, the action of a point upon a plate may be considered the same as upon an indefinitely large hemisphere, towards which, as the point approaches, the force increases.

February 8, 1838.

STEPHEN PETER RIGAUD, Esq., Vice-President, in the Chair.

George Lowe, Esq., who, at the Anniversary of 1836, had ceased to be a Fellow, from the non-payment of his annual contributions, was, at this meeting, re-admitted by ballot into the Society, agreeably to the provision of the Statutes.

James Bateman, Esq.; Joseph Glynn, Esq.; William Hallows Miller, Esq., M.A.; the Rev. Joseph Bancroft Reade, M.A.; Robert Bentley Todd, M.D.; and Alexander Tweedie, M.D., were elected Fellows.

A paper was read, entitled, " Researches towards establishing a Theory of the Dispersion of Light", No. IV. By the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

In his former communications to the Royal Society the author had instituted a comparison of the results of observation and of theory with regard to the dispersion of light, in the instances of the respective indices for the standard rays in fifteen different cases of transparent media; and had found a sufficiently close agreement in the cases which gave the lower numbers; but there yet appeared to be an increasing discrepancy as an advance was made towards the higher. The theoretical formula employed in this investigation was one derived from the undulatory hypothesis, by a process involving some limitations, which rendered it only approximative. By pursuing the calculations to a greater degree of developement, or by adopting methods of a more precise character, such as those of M. Cauchy and of Mr. Kelland, the author was led to hope that a more close coincidence might be obtained. The formulæ of M. Cauchy, however, involved calculations of so elaborate and overwhelming a character, that he was induced to make trial of the method of Mr. Kelland, applying it, in the first instance, to the case of the most highly dispersive substance, namely, oil of Cassia, in which the greatest discrepancy had before appeared.

The object of the present communication is to state the results obtained, together with the necessary data employed in the calculations; and also to elucidate the general method, so as to render it more easily applicable to other cases which may arise in the further prosecution of the determination of specific indices. For this purpose a general statement is given of Mr. Kelland's method, in whose formulæ, it is easy, knowing the value of the wave-length in air, and taking the indices as given by observation for that particular medium, to introduce the values of the wave-length in the medium. Two of the constants are then determined for that medium; and by the aid of these, combined with the indices given by observation, a value of the third constant is deduced for each ray: and the verification of the theory will result from the equality of the respective values of this latter constant thus obtained.

The author then gives tables exhibiting the comparison of observed refractive indices with the results of Mr. Kelland's theory; first, in the case of sulphuret of carbon, at a temperature of 12° (centigrade); next, of the same substance at 22°; and lastly, of oil of Cassia: from which it appears, that the accordance between the results of observation and of theory is sufficiently within the limits of the errors in the experimental data to satisfy all reasonable expectation.

A paper was also in part read, entitled, " Experimental Researches in Electricity." Twelfth Series. By Michael Faraday, Esq., D.C.L., F.R.S., &c.

A letter was read from Dr. Marshall Hall, in reply to a note contained in the paper of Mr. Newport, published in the last volume of the Philosophical Transactions.

sioned by a momentary and independent action of the same kind. The disruptive discharge may take place at degrees of tension so low as not to give rise to any luminous appearance; so that a dark space may intervene in the line of actual discharge, as is frequently observable between the brush on one side, and the glow on the other. Thus it is inferred that electric light is merely a consequence of the quantity of electricity which, after a discharge has commenced, flows and converges towards the spot where it finds the readiest passage: and these conclusions are further confirmed by the phenomena which take place in other gases, besides atmospheric air, and which are specifically detailed by the author.

The last kind of discharge which is here considered is the *convective* or *carrying discharge*, namely, that effected by the translation of charged particles from one place to another. The phenomena attending this mode of transference are examined under various aspects as they occur in air, in liquids of various kinds, in flame, and as they are exhibited in the case of particles of dust, which perform the office of carriers of the electricity; and also in that of solids terminated by liquids. Thus all these apparently isolated phenomena comprised under the heads of the electric currents which characterize electrolyzation, of transference through dielectrics by disruptive discharges of various kinds, or by the actual motion of charged particles, and of conduction through conductors of various degrees of power, are assimilated to one another by their being shown to be essentially the result of actions of contiguous particles of matter assuming particular states of polarization.

The author lastly considers electric currents, not only in their effects on the bodies they traverse, but also in their collateral influences as producing inductive and magnetic phenomena. The analogies, which connect electrolytic discharge with that by conduction, are pointed out, as tending to show that they are essentially the same in kind, and that when producing different kinds of motion in the particles of matter, their mode of operation may be regarded as identical. An attempt is made to connect with these views the lateral or transverse actions of currents, which are most distinctly manifested in their magnetic effects; these effects being produced equally by the disruptive, the conductive, and the electrolytic discharges, and probably depending on the transverse condition of the lines of ordinary induction. This transverse power has the character of polarity impressed upon it, and, in its simplest form, appears as attractive or repulsive, according as the currents themselves are in the same, or in opposite directions. In the current and in the magnet it assumes the condition of tangential force; and in magnets and their particles it produces poles.

The author announces that he intends shortly to develop, in another series of these researches, some further views which he entertains concerning the nature of electric forces and electric excitation in connexion with the theory he has here advanced.

The Society then adjourned over the Easter Recess to meet again on the 26th instant.

ball is rendered positively *inductric*; and that a similar difference, though to a less extent, is observable, when the smaller ball is rendered negative. The smaller ball, rendered positive, gives also a much longer spark than when it is rendered negative; in which latter case, however, it affords, at equal distances, a luminous brush of greater size, and gives it much more readily than when positive. In order to ascertain the relative degrees of charge which the balls acquire before the occurrence of the discharge, the author employed an apparatus attached to the insulated conductor of the electrical machine, and also to the conductor connected with the discharging train, and consequently uninsulated, consisting, on each side, of a rod branching out in the form of a fork, and terminating, at one of its extremities in a large ball, and at the other in a small one; the position of the forks being capable of adjustment, so that the large ball of each rod might be brought exactly opposite to the small one of the other: and the distances between each pair admitted of being regulated at pleasure, until the discharges through each interval were rendered apparently equal to one another. From numerous experiments made with this instrument, the author concludes that when two conducting surfaces of small but equal size, are placed in air, and electrified, the one positively and the other negatively, a discharge takes place at a lower tension from the latter than from the former; but that, when a discharge does occur, a greater quantity of electricity passes at each discharge from the positive, than from the negative surface. Experiments of a similar nature were made in gases of different kinds, by enclosing them in an apparatus constructed on the same plan as the former one, but capable of acting in a receiver, from which the air could be exhausted, and the particular gas, whose powers in modifying the electric discharges were to be ascertained, could be introduced in its place. The results of various trials are given in a table, from which it appears that different gases restrain the discharge in very different degrees. The discharge from the small ball, through nitrogen and hydrogen gases, most readily takes place when the charge is positive; and through oxygen, carbonic acid, and coal gas, when it is negative.

The author next directs his attention to the peculiar luminous phenomena attending the disruptive electrical discharge, which he terms *a glow*, and which appears to depend on a quick, and almost instantaneous charge given to the air in the immediate vicinity, and in contact with the charged conductor; and he enters into a detailed account of the circumstances by which it is influenced, and its production favoured; such as diminution of the charging surface, increase in the power of the machine, rarefaction of the surrounding air, and the particular species of electricity concerned. The relations which the glow, the brush, and the spark bear to one another, as well as the steps of transition between each are minutely investigated; and the conclusion is deduced that the glow is in its nature exactly the same as the luminous part of a brush or ramification, namely, a charge of air; the only difference being that the glow has a continuous appearance from the constant renewal of the same action in the same place, whereas the ramification is occa-

neral Wilson. Communicated by S. H. Christie, Esq., M.A., Sec. R.S.

The author states that the Régar of India is found, by chemical analysis, to consist of silica, in a minute state of division, together with lime, alumina, oxide of iron, and minute portions of vegetable and animal *débris*. Hence it is usually considered as having been formed by the disintegration of trap rocks: the author, however, after examining its numerous trap dykes traversing the formation of the ceded districts, which he found invariably to decompose into a ferruginous red soil, perfectly distinct from the stratum of black régar through which the trap protrudes, was led to regard this opinion of its origin as erroneous: and from the circumstance of its forming an extensive stratum of soil covering a large portion of the peninsula of India, he believes it to be a sedimentary deposit from waters in a state of repose.

Specimens of basaltic trap and of the Régar soil were transmitted to the Society by the author, for the purpose of analysis.

The reading of a paper, entitled, "Experimental Researches in Electricity," Thirteenth Series, by Michael Faraday, Esq., D.C.L., F.R.S., &c., was resumed but not concluded.

March 29, 1838.

JOHN GEORGE CHILDREN, Esq., V.P., in the Chair.

Simon MacGillivray, Esq., was elected a Fellow of the Society.

The reading of a paper, entitled, "Experimental Researches in Electricity," Thirteenth Series, by Michael Faraday, Esq., D.C.L., F.R.S., was resumed but not concluded.

April 5, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

John Hardwick, John Macneill, and Edward William Tuson, Esqs., were elected Fellows of the Society.

The reading of a paper, entitled, "Experimental Researches in Electricity," Thirteenth Series, by Michael Faraday, Esq., D.C.L., F.R.S., was resumed and concluded.

The author, in this paper, pursues the inquiry into the general differences observable in the luminous phenomena of the electric discharge, according as they proceed from bodies in the positive or the negative states, with a view to discover the cause of those differences. For the convenience of description he employs the term *inductric*, to designate those bodies from which the induction originates, and *inducteous* to denote those whose electric state is disturbed by this inductive action. He finds that an electric spark, passing from a small ball, rendered positively *inducteous*, to another ball of larger diameter, is considerably longer than when the same

tained by the latter, he finds that in the bark of the bamboo and the epidermis of straw the silica incrusting these tissues is not crystallized, but, on the contrary, exhibits, both before and after incineration, the most beautiful and elaborate organization, consisting of an arranged series of cells and tubes, and differing in its character in different species of the same tribe, and in different parts of the same plant.

The observations of Mr. Golding Bird, contained in the 14th number of the Magazine of Natural History, New Series, are then referred to; and the author states in confirmation, that, by employing caustic potash, the siliceous columns may be removed from the leaf of a stalk of wheat, while the spiral vessels and ducts, which form the principal ribs of the leaf, as well as the apparently metallic cups which are arranged on its surface, remain undisturbed. He proposes, therefore, to substitute, in the description of vegetable tissues, the term *skeleton*, instead of that of *bases*, whether saline or siliceous, of those tissues.

March 15, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

Captain Thomas Best Jervis, E.I.C.S., and Travers Twiss, Esq., were elected Fellows of the Society.

The reading of a paper, entitled, "Experimental Researches in Electricity," Thirteenth Series, by Michael Faraday, Esq., D.C.L., F.R.S., &c., was commenced.

March 22, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

A paper was read, entitled, "Description of a new Tide-Gauge, constructed by T. G. Bunt, and erected on the Eastern bank of the River Avon, in front of the Hotwell House, Bristol, in 1837." Communicated by the Rev. William Whewell, M.A., F.R.S.

The principal parts of the machine here described, are an eight-day clock, which turns a vertical cylinder, revolving once in twenty-four hours; a wheel, to which an alternate motion is communicated by a float rising and falling with the tide, and connected by a wire with the wheel which is kept constantly strained by a counterpoise; and a small drum on the same axis with the wheel, which by a suspending wire communicates one 18th of the vertical motion of the float to a bar carrying a pencil which marks a curve on the cylinder, or on a sheet of paper wrapped round it, exhibiting the rise and fall of the tide at each moment of time. The details of the mechanism, illustrated by drawings, occupy the whole of this paper.

A paper was also read, entitled, "On the Régar or Black Cotton Soil of India," by Capt. Newbold, Aide-de-Camp to Brigadier-Ge-

ingly conducted in preference to other lines of transit. The variety in the appearance of the electric spark taken in different gases may be ascribed partly to different degrees of heat evolved, but chiefly to specific properties of the gas itself with relation to the electric forces. These properties appear also to give occasion to diversities in the form of the pencil or brush, which takes place when the discharge is incomplete, and is repeated at short intervals, according to the shape of the conductor on either side, and according to the species of electricity conveyed. The diverging, converging, bent and ramified lines presented in these different forms of electric discharge, strikingly illustrate the deflexions and curvilinear courses taken by the inductive actions which precede the disruption ; these lines being not unlike the magnetic curves in which iron filings arrange themselves when under the action of opposite magnetic polarities.

March 8, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

Colonel Andrew Leith Hay, K.H., who had at the last Anniversary ceased to be a Fellow from the non-payment of his annual contribution, was at this meeting re-elected by ballot into the Society.

A paper was read, entitled, "Proposal for a new method of determining the Longitude, by an absolute Altitude of the Moon," by John Christian Bowring, Esq. Communicated by John George Children, Esq., F.R.S.

The method employed by the author for determining the longitude by the observation of an absolute altitude of the moon, was proposed, many years ago by Pingré and Lemmonier; and the principal difficulty which stood in the way of its adoption, was its requiring the exact determination of the moon's declination reduced to the place of observation. This difficulty the author professes to have removed by supposing two meridians for which the altitudes are to be calculated: and the only remaining requisite is the accurate determination of the latitude, which presents no great difficulty, either on land or at sea. Examples are given of the practical working of this method; showing that if the latitude of a place of observation be obtained within a few seconds, the longitude will be found by means of a single observation of the altitude of the moon.

A paper was also read, entitled, "An Inquiry into a new Theory of earthy Bases of Vegetable Tissues," by the Rev. J. B. Reade, M.A., F.R.S.

The author, after briefly noticing the results of some of his experiments described in two papers which appeared in the Philosophical Magazine for July and November, 1837, and also those of Mr. Robert Rigg in a paper read to the Royal Society, next adverts to the theory of M. Raspail, detailed in his *Tableau Synoptique*, and *Nouveau Système de Chimie*. In opposition to some of the views enter-

quired during the previous polarization. The lines of inductive action which occur in fluid electrolytes are exemplified by employing for that purpose clean rectified oil of turpentine, containing a few minute fibres of very clean dry white silk; for when the voltaic circuit is made by the introduction into the fluid of wires, passing through glass tubes, the particles of silk are seen to gather together from all parts, and to form bands of considerable tenacity, extending between the ends of the wires, and presenting a striking analogy to the arrangement and adhesion of the particles of iron filings between the poles of a horse-shoe magnet.

The fact that water acquires greater power of electrolytic induction by the addition of sulphuric acid, which not being itself decomposed, can act only by giving increased facility of conduction, is adduced as confirming the views of the author.

The phenomena of the disruptive electric discharge are next examined with reference to this theory: the series of inductive actions which invariably precede it are minutely investigated: and reference is made to the accurate results obtained by Mr. Harris, as to the law of relation between the intensity of a charge, and the distance at which a discharge takes place through the air.

The theory of Biot and others, which ascribes the retention of a charge of electricity in an insulated body to the pressure of the surrounding atmosphere, is shown to be inconsistent with various phenomena, which are readily explained by the theory adopted by the author.

The author then enters into an inquiry relative to the specific conducting capacities of different dielectrics.

With a view of determining the degrees of resistance to the transit of electricity excited by different kinds of gases, he constructed an apparatus, in which an electric discharge could be made along either of two separate channels; the one passing through a receiver filled with the gas, which was to be the subject of experiment, and the other having atmospheric air interposed. By varying the length of the passage through the latter, until it was found that the discharge occurred with equal facility through either channel, a measure was afforded of the relative resistances in those two lines of transit, and a determination consequently obtained of the specific insulating power of the gas employed.

The circumstances attending the diversified forms of the disruptive discharge, such as the vivid flash or spark, the brush or pencil of light, and the lucid point or star, which severally represent different conditions of the sudden transit of electrical forces through an intervening dielectric, are minutely investigated in their various modifications. The spark is the discharge, or reduction of the polarized inductive state of many dielectric particles, by the particular action of a few of those particles occupying but a small and limited space, leaving the others to return to their original or normal condition in the inverse order in which they had become polarized: and its path is determined by the superior tension which certain particles have acquired, compared with others, and along which the action is accord-

those at a distance, and which comprehend the phenomena of the *electric discharge.* Having considered, in the preceding paper, the process by which the former condition is established, and which consists in the successive polarization of series of contiguous particles of the interposed insulating dielectric; the author here proceeds to trace the process, which, taking place consequently on simple induction, terminates in that sudden, and often violent interchange of electric forces constituting *disruption*, or the electric discharge. He investigates, by the application of his theory, the gradual steps of transition which may be traced between perfect insulation on the one hand, and perfect conduction on the other, derived from the varied degrees of specific electric relations subsisting among the particular substances interposed in the circuit: and from this train of reasoning he deduces the conclusion that *induction* and *conduction* not only depend essentially on the same principles, but that they may be regarded as being of the same nature, and as differing merely in degree.

The fact ascertained by Professor Wheatstone, that electric conduction, even in the most perfect conductors, as the metals, requires for its completion a certain appreciable time, is adduced in corroboration of these views; for any retardation, however small, in the transmission of electric forces can result only from induction; the degree of retardation, and, of course, the time employed, being proportional to the capacity of the particles of the conducting body for retaining a given intensity of inductive charge. The more perfect insulators, as lac, glass and sulphur, are capable of retaining electricity of high intensity; while, on the contrary, the metals and other excellent conductors, possess no power of retention when the intensity of the charge exceeds the lowest degrees. It would appear, however, that gases possess a power of perfect insulation, and that the effects generally referred to their capacity of conduction, are only the results of the carrying power of the charged particles either of the gas, or of minute particles of dust which may be present in them: and they perhaps owe their character of perfect insulators to their peculiar physical state, and to the condition of separation under which their particles are placed. The changes produced by heat on the conducting power of different bodies is not uniform; for in some, as sulphuret of silver and fluoride of lead, it is increased; while in others, as in the metals and the gases, it is diminished by an augmentation of temperature.

One peculiar form of electric discharge is that which attends *electrolyzation*, an effect involving previous induction; which induction has been shown to take place throughout linear series of polarized particles, in perfect accordance with the views entertained by the author of the general theory of inductive action. The peculiar feature of this mode of discharge, however, is in its consisting, not in a mere interchange of electric forces at the adjacent poles of contiguous particles, but in their actual separation into their two constituent particles; those of each kind travelling onwards in contrary directions, and retaining the whole amount of the force they had ac-

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1838. No. 32.

February 15, 1838.

DAVIES GILBERT, Esq., Vice-President, in the Chair.

A paper was in part read, entitled "Experimental Researches in Electricity," Twelfth Series, by Michael Faraday, Esq., D.C.L., F.R.S., &c.

February 22, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

William Thomas Denison, Esq., R.E., and Joseph Locke, Esq., were elected Fellows of the Society.

The reading of a paper, entitled, "Experimental Researches in Electricity," Twelfth Series, by M. Faraday, Esq., D.C.L., F.R.S., was resumed.

March 1, 1838.

The Right Honourable the EARL of BURLINGTON, Vice-President, in the Chair.

Alexander Wilson, Esq., was elected a Fellow of the Society.

The reading of a paper, entitled "Experimental Researches in Electricity," Twelfth Series, by Michael Faraday, Esq., D.C.L., F.R.S., &c., was resumed and concluded.

Experimental Researches in Electricity: Twelfth Series. By Michael Faraday, Esq., D.C.L., F.R.S., Fullerian Professor of Physiology in the Royal Institution of Great Britain.

The object of the present series of researches is to examine how far the principal general facts in electricity are explicable on the theory adopted by the author, and detailed in his last memoir, relative to the nature of inductive action. The operation of a body charged with electricity, of either the positive or negative kind, on other bodies in its vicinity, as long as it retains the whole of its charge, may be regarded as *simple induction*, in contradistinction to the effects which follow the destruction of this statical equilibrium, and imply a transit of the electrical forces from the charged body to

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1838. No. 33.

April 26, 1838.

STEPHEN PETER RIGAUD, Esq., Vice-President, in the Chair.

A paper was read, entitled, "An Account of a line of Levels, carried across Northern Syria, from the Mediterranean Sea to the River Euphrates." By William Taylor Thomson, Esq., with Geological and Botanical Notes, by William Ainsworth, Esq. Communicated by Captain Beaufort, R.N., F.R.S., &c.

The operation of carrying a line of levels across Northern Syria, from the Mediterranean sea to the river Euphrates, was undertaken by Colonel Chesney, at the time he commanded the expedition sent to that river in the year 1835, chiefly with a view to determine the capabilities of the intervening country for the establishment of communications by roads, railways, or canals; but it was expected also that the examination would afford information of much historical and geographical interest. It was commenced in August of the same year, by Lieutenant Murphy and Mr. Thomson, assisted by Sergeant Lyne, R.E., Gunner Waddell, and some Maltese: but most of the party being disabled by sickness, and their numbers reduced by deaths and removals, the levelling was at length conducted principally by Mr. Thomson, with the assistance, in the latter part of the work, of Mr. Elliott, commonly called Dervish Ali. The result of this great labour was to determine the bed of the Euphrates to be 628 feet above the level of the Mediterranean.

The whole of the district over which the line of levels was carried naturally divides itself into four regions, each of which is characterized by its relative elevation, its peculiar geological structure, its vegetation, and the manners and habits of its population.

The first region, commencing from the Euphrates, comprises the country of the upper chalk and conide limestones, which averages an elevation of 1300 feet, and is but slightly undulated. The soil is light, somewhat stony, and of no great depth, and is highly productive in crops of corn and cotton. These uplands are inhabited by stationary Turcomans and Arabs, who are a mixed race of Fellahs. The large plains of this region are studded over in every direction with numerous mounds, of a more or less circular form, called by the Arabs *Tets*, and by the Turcomans *Heuks*, the origin of which appears to be partly natural and partly artificial. A village is found at the foot of almost every one of these monticules.

The second region comprises the country of ostracite limestone and feldspath pyroxenic rocks, in the valley of Ghuidaries and the Aphrean, having a mean elevation of 450 feet. This district is extremely fertile, for the most part cultivated, and inhabited by agricultural Kurds.

The third region is the lacustrine plain of Umk, elevated about 305 feet above the Mediterranean, and covered, for the most part, with the gramineous plants which feed the flocks of the pastoral and nomadic Turcomans.

The fourth region, formed by the valley of Antioch, is rocky, irregular, and varying from elevations of 220 to 440 feet. It comprises also the alluvial plain of the Orontes, which gradually sinks to the level of the Mediterranean. This latter district is covered with shrubs, which are chiefly evergreens; and inhabited by a few families of Syrians, who, in these picturesque solitudes, chiefly follow mysterious rites, presenting a mixture of Mahomedanism and Christianity.

It appears, from the examination of this line of country, that there here exist two distinct regions, the one low and already furnished with the means of water transport; and the other elevated, where the waters, which are lost in the valley of Aleppo, might be turned with facility into an artificial channel. Both regions are remarkably level, and present, when separately viewed, very few difficulties to be overcome for the construction of artificial roads.

May 3, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

Thomas Burnet, D.D., Sir James Rivett Carnac, Bart., John Merewether, D.D., Benjamin Fonseca Outram, M.D., Jonathan Pereira, Esq., and Edward Hamilton Stirling, Esq., were severally elected Fellows of the Society.

A paper was read, entitled, "Supplementary Note to the Thirteenth Series of Experimental Researches in Electricity." By Michael Faraday, Esq., D.C.L., F.R.S., &c.

The author describes, in this supplementary note, experiments made with the view of determining the specific inductive capacities of dielectrics, by means of an apparatus of the following form. Three circular brass plates were mounted, side by side, on insulated pillars; the middle one was fixed, but the two outer plates were moveable on slides, so that all three could be brought with their sides almost into contact, or separated to any required distance. Two gold leaves were suspended in a glass jar from insulated wires, connecting each of the leaves respectively with the adjacent outer plate. The amount of disturbance in the electric equilibrium of the outer plates produced by interposing a plate of the dielectric substance to be tried, after charging the middle plate, was taken as a measure of the specific inductive capacity of that dielectric. By varying the size and

distances of the plates, and also the distance of the gold leaves from one another, new conditions are supplied for the more exact determination of the relative inductive powers of dielectrics of every description; and by sufficiently reducing the dimensions of the instrument, it may be rendered applicable to comparatively small masses of dielectrics, such as crystals, and even diamonds. An instrument capable of such universal application the author proposes to designate by the name of *Differential Inductometer*.

Also read, a Letter addressed to P. M. Roget, M.D., Secretary to the Royal Society, by James Ivory, Esq., F.R.S., accompanying a paper on Astronomical Refractions. Communicated by Dr. Roget.

The author adverts in this letter to the attempts made by Newton to solve the problem of atmospherical refractions, which were baffled by the experience that the observed quantities fall far short of the theoretical deductions; whence he justly inferred that some new cause must be sought for capable of effecting that change in the density of the lower part of the atmosphere which is required for reconciling theory with observation. It becomes necessary, in particular, to investigate the law according to which the temperature diminishes as the height increases. The initial value of the rate of diminution has to be determined by experiment; and the introduction of this new element into the equation of an atmosphere in equilibrium must be an approach to the true solution of the problem of the refractions, and is indispensable if arbitrary assumptions are to be avoided. The author proceeds to notice Laplace's solution, which, though highly ingenious, is nevertheless hypothetical; and he adverts to the want of precision exhibited in Biot's dissertation on the influence which the presence of aqueous vapour in the air has on the refractions: but refers to the paper which accompanies his letter for the further explanation of his views on this subject.

A paper was also in part read, entitled, "On the Theory of the Astronomical Refractions," by James Ivory, Esq., K.H., M.A., F.R.S., &c.

May 10, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

The reading of Mr. Ivory's paper "On the Theory of Astronomical Refractions," was resumed.

The Society then adjourned, in consequence of the 17th having been fixed for celebrating Her Majesty's Birth-day, to meet again on the 24th instant.

May 24, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

His Imperial and Royal Highness Leopold II., Grand duke of Tuscany, was elected a Fellow.

The reading of the paper by Mr. Ivory, "On the Theory of the Astronomical Refractions," was concluded.

In this communication, the author, after stating that the mean refractions are the object of investigation, and fully defining what he understands by this term, gives an historical review of what has been done up to the present time on this very important subject. Having stated that the foundation of the theory of astronomical refractions was laid by Dominique Cassini, he deduces on Cassini's hypothesis (that of an homogeneous atmosphere) a formula for the refraction, which agrees exactly with that of La Place, employed in computing the first part of the table of mean refractions, published by the French Board of Longitude.

The labours of our immortal countryman Newton, in this vast field of inquiry, are next reviewed. As the density of the atmosphere in ascending decreases gradually, the path described by a ray from a star, in its passage through the atmosphere, is not a straight line, as it would be on Cassini's hypothesis, but is a curve more and more inflected towards the earth's centre. In the Principia there is found whatever is necessary for determining the nature of this curve, and, consequently, for solving the problem of the astronomical refractions, which consists in ascertaining the difference between the direction of light when it enters the atmosphere, and its ultimate direction when it arrives at the earth's surface.

On the principles established in the second section of the Principia, the author deduces equations requisite for the solution of the problem of astronomical refractions, and remarks that these equations are perfectly general, and will apply in any constitution of the atmosphere that may be adopted. In this investigation, in preference to employing functions with peculiar properties to express the molecular action, the manner in which the forces act has been considered. When the light, in passing through the atmosphere, arrives at a surface of increased density, it receives an impulse which may be considered as instantaneous; and this impulse being distributed over the breadth of a stratum of uniform density, ascertains the centripetal force tending to the earth's centre, by the action of which the trajectory is described.

It appears, that Newton himself was the first to apply this new method to the problem of the astronomical refractions. In his first attempt he assumes that the densities decrease in ascending, in the same proportion as the distances from the earth's centre increase. On this supposition the author investigates a formula, which M. Biot has also obtained, and which is equivalent to the construction communicated by Newton to Flamsteed. On this basis a table was computed and communicated to Flamsteed; but Newton subsequent-

ly informed Flamsteed that he did not intend to publish it, in consequence of a serious objection to the supposed scale of densities. Adopting the principles in the twenty-second proposition of the second book of his Principia, Newton, it appears, succeeded at length in computing a second table of refractions, which he likewise communicated to Flamsteed, and which, there is every reason to think, is the same which he gave to Halley, and which was inserted by that astronomer in the Philosophical Transactions for 1721. As the determining whether the two tables are identical is a question of much interest, the author enters very fully into it, and, from the results of elaborate calculations, concludes that Halley's table is no other than the one which Newton calculated on the supposition that the densities in the atmosphere are proportional to the pressures. He remarks that, as far as the mathematics are concerned, the problem of the astronomical refractions was fully mastered by Newton.

After referring to the labours of Brook Taylor, Kramp, and Thomas Simpson, the author again adverts to Newton's views, remarking that, in assigning the rarefaction of the lower region of the atmosphere by heat as the cause why the calculated refractions near the horizon so much exceeded the observed, as was found to be the case, Newton had assigned the true cause; but that he had no clear conception of the manner in which the density in the lower region is altered by the agency of heat; and he considers that nearly the same ignorance in that respect still prevails.

The two atmospheres, with densities decreasing in arithmetical and geometrical progression, which, it now appears, were imagined by Newton, and which have been discussed by Thomas Simpson and other geometers, are found, when the same elements are employed, to bring out horizontal refractions on opposite sides of the observed quantities. La Place conjectured that an intermediate atmosphere which should partake of the nature of both, and should agree with observation in the horizontal refraction, would approach nearly to the true atmosphere. If recourse be had to the algebraical expressions of La Place, it will be found that the atmosphere he proposes is one of which the density is the product of two terms, the one taken from an arithmetical, the other from a geometrical series; the effect of which combination is to introduce a supernumerary constant, by means of which the horizontal refraction is made to agree with the true quantity. The author considers, with Dr. Brinkley, that the French table, founded on La Place's investigation, is only a little less empirical than the other tables, and that the hypothesis of La Place does not appear to possess any superiority over other supposed constitutions of the atmosphere in leading to a better and less exceptionable theory.

After eulogizing Bessel's tables of mean refractions, published in his *Tabulæ Regiomontanæ*, the author refers to his own paper in the Philosophical Transactions for 1823. In this paper the refractions are deduced entirely from the very simple formula,—

$$\frac{1+\beta r'}{1+\beta r''}=1-f\left(1-c^{-u}\right)$$

in which β stands for the dilatation of air or gas by heat, τ' and τ'' for the temperature at the earth's surface, and at any height above it, and c^{-u} for the density of the air at that height in parts of its density at the surface. If this formula be verified at the earth's surface in any invariable atmosphere, by giving a proper value to the constant f, it will still hold, at least with a very small deviation from exactness, at a great elevation; and this is immediately shown.

This manner of arriving at the constitution of the atmosphere is contrasted with the procedure of M. Biot of transforming an algebraical formula, for the express purpose of bringing out a given result. As the problem in the *Mécanique Céleste* is solved by means of an interpolated atmosphere between two others; as in Mr. Ivory's paper of 1823, there is no allusion to such an atmosphere; and as the table in that paper is essentially different from all the tables computed by other methods, he contends that all these must be sufficient to stamp an appropriate character on his solution of the problem. But if ingenuity could trace some relation, in respect of the algebraic expression, between the paper of 1823 and La Place's calculations, he considers that it is not difficult to find, between the same paper and the view of the problem taken by the author of the Principia in 1696, an analogy much more simple and striking. Newton having solved the problem, on the supposition that the density of the air is produced solely by pressure, and having found that the refractions thus obtained greatly exceeded the observed quantities near the horizon, inferred, in the true spirit of research, that there must be some cause not taken into account, such as the agency of heat, which should produce, in the lower part of the atmosphere, the proper degree of rarefaction necessary to reconcile the theoretical with the observed refractions. The author's sole intention, in introducing the quantity f in his formula, is to cause the heat at the earth's surface to decrease in ascending, at the same rate that actually obtains in nature, not before noticed by any geometer, but which evidently has the effect of supplying the desideratum of Newton.

The author considers, that the comparison of the table in the paper of 1823, with the best observations that could be procured at the time of publication, was satisfactory; and after the publication of the *Tabulæ Regiomontanæ*, he found that the table agreed with Bessel's observed refractions to the distance of 88° from the zenith, with such small discrepancies as may be supposed to exist in the observations themselves.

The paper in the Philosophical Transactions for 1823, however, takes into account only the rate at which the densities, in a mean atmosphere, vary at the surface of the earth; but, in the present communication, the author proposes to effect the complete solution of the problem, by estimating the effect of all the quantities on which the density at any height depends. For this purpose, he finds it necessary to employ functions of a particular kind; and then gives a formula, one part of which consists of a series of these functions, for the complete expression of the temperature of an atmosphere in equilibrium; the intention of assuming this formula being to ex-

press the temperature in terms of such a form as will produce, in the refraction, independent parts that decrease rapidly. By this means he proceeds in the analytical investigation of the problem in its more comprehensive form, and deduces two equations on which its solution depends.

The first of these contains the law according to which the heat decreases as the height above the earth's surface increases; and the second determines the perpendicular ascent, when the difference of the pressures and of the temperatures at its upper and lower extremity have been found. If the latter, with a slight transformation, be multiplied by the proper factor, representing the variable force of gravity in different latitudes, it becomes identical with the usual barometric formula, all its minutest corrections included; and it has this advantage; that, whereas the usual formula is investigated on the arbitrary assumption, that the temperature is constant at all the points of an elevation, and equal to the mean of the temperatures at the two extremities, this formula is strictly deduced from the general properties of an atmosphere in equilibrium.

Having determined, from experimental results, the values of certain constants in these formulæ,—first, in an atmosphere of dry air, and, secondly, in an atmosphere of air mixed with aqueous vapour, the author remarks, that the analytical theory agrees in every respect with the real properties of the atmosphere, as far as these have been ascertained.

The object of Mr. Ivory's further investigation is to show, that the same theory represents the astronomical refractions with a fidelity that can be deemed imperfect only as far as the values of particular constants, which can only be determined by experiment, are liable to the charge of inaccuracy. He therefore proceeds to determine, from the formulæ previously deduced, the refraction of a star in terms of its apparent zenith distance. For this purpose, the differential equations are transformed by the introduction of new symbols; the limits of certain terms are determined previously to their being neglected; and the equation is finally reduced to a form, in which the remaining operations consist in investigating the integrals of four expressions, and in subsequently assigning their numerical values. Great skill is displayed in conducting these intricate investigations; and after going through the most laborious calculations and computations, the author exhibits a table of theoretical refractions, deduced solely from the phenomena of the atmosphere, for zenith distances, extending from 10° to 89½°. These refractions are compared with those in Bessel's table, in the *Tabulæ Regiomontanæ*, and also with those in the table in the *Connaissance des Temps*. From this comparison, it appears, that the three tables agree within less than 1″, as far as 80° from the zenith: from 80° to 88° of zenith distance, the numbers in the French table exceed those in Bessel's, the excess being 2″ at 84°, and 4″ at 88°; and with a single exception at 88°, (probably, judging from the character of the adjacent number, arising from an error of computation,) the refractions in the new table are nearer to Bessel's than those in the French table;

but when the zenith distance is greater than 80°, the author considers the accuracy of the French table questionable, both on account of the hypothetical law of the densities, and because the quantity assumed for the horizontal refraction is uncertain.

After giving a few examples, illustrative of the use of the new table, the author inquires how far the refractions are likely to be affected by the term which it was found necessary to leave out, because the present state of our knowledge of the phenomena of the atmosphere made it impossible to determine the coefficient by which it is multiplied. For this purpose, the variable part of that term has been computed for every half degree, from 85° to 88°, and the results are exhibited in a table. From this it appears, that this coefficient, although considerably less than that of the preceding term, may still have some influence on the refractions at very low altitudes. The mean refraction in Bessel's table, and in the new table, can hardly be supposed to differ 2″ from the true quantity, which would limit the coefficient in question to be less than one-tenth. It is a matter of some importance to obtain a near value of this coefficient; and it is probable that this can be accomplished in no other way, than by searching out such values of the two coefficients as will best represent many good observed refractions at altitudes less than 5°. If such values were found, our knowledge of the decrease of heat in ascending in the atmosphere would be improved, and the measurement of heights by the barometer would be made more perfect.

At the end of the paper is given a table of mean refractions for the temperature 50° Fahr. and barometric pressure 30 inches, at every degree from 0° to 70° zenith distance, and at every 10′ from 70° to the horizon; and tables of the corrections requisite for variations of the thermometer and barometer are subjoined.

May 31, 1838.

DAVIES GILBERT, Esq., V.P., in the Chair.

The Rev. John Hymers was duly elected a Fellow of the Society.

A paper was read, entitled, "Remarks on the Theory of the Dispersion of Light, as connected with Polarization." By the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

The present paper is a sequel to those already presented by the author to the Royal Society, in which he had instituted a comparison of the observations of the refractive indices for the standard rays of light in various media, with the results calculated from theoretical formulæ, deduced from the most improved views of the undulatory hypothesis; the cases discussed including the greatest range of data as yet furnished by experiment. The comparison exhibited an accordance sufficient to warrant the conclusion that the theory af-

fords a very satisfactory approximation, at least, to the expression and explanation of the actual law of nature. In order, however, to remove any possible discrepancy which may still exist, or hereafter be found to obtain, the author considers that further examination is requisite of the principles on which any extension or modification of the theory might be pursued; and such is the object of the investigation undertaken in the present paper.

The phenomena of interference, on which the undulatory theory was originally based by Dr. Young, obliged us to adopt some idea of an alternating motion, as well as a motion of translation, in our conception of light; and this, with all the accessions it has received, especially from the investigation of Fresnel, has, at the present day, been connected by the labours of M. Cauchy and others, with general dynamical principles, which regulate the propagation of vibratory motions through an elastic medium. From such dynamical principles there have been deduced certain differential equations of motion, the integration of which gives the well-known expression for a wave, involving the relation between the velocity and the wave-length which explains the dispersion. The direct and complete integration of these forms, effected by M. Cauchy, and simplified by Mr. Tovey and M. Kelland, involves certain conditions; namely, the evanescence of certain terms, the interpretation of which implies peculiar views of the constitution of the ether. Mr. Tovey shows that without these conditions, a certain form of the wave-function is a particular solution of the equations; and this form is precisely that expressing elliptically polarized light. If the absence of the condition in question be essential to the case of elliptically and circularly polarized light, it follows that all the preceding investigations, which depend on the fulfilment of those conditions, are applicable only to unpolarized and plane-polarized light, and consequently the general integration is limited in a most material part of its application; a defect which is only remedied by the supplementary investigation of Mr. Tovey, in which, for this case, a particular solution is assigned. It seemed, then, necessary to show explicitly that the non-fulfilment of the conditions, that is, the non-evanescence of the terms in question, is essential for elliptically polarized light, as their evanescence is for common light, and thus to exhibit distinctly the relation between the cases of elliptically polarized, of plane-polarized, and unpolarized light; and, again, to remove, if possible, the obscurity and discrepancy of opinion in which the physical interpretation of those conditions, with regard to the supposed constitution of the ethereal medium, appeared to be involved.

The author then enters upon the analytical investigation of the subject, and in conclusion remarks that when light is elliptically or circularly polarized, that is, when any one of the two component vibrations is retarded behind the other, then, in the differential equations of motion, the opposite terms do not destroy each other in the summation, which they can only do in general by supposing a great number taken into account; that is, the number of terms is limited, or the sphere of the influence of the force by which the vibrations

are propagated is small. When light is plane-polarized, or unpolarized, that is, when there is no retardation, or the phases of the component vibrations are simultaneous, then the opposite sums destroy each other; that is, the number of terms involved is greater, or the sphere of the influence of the force greater. Since both kinds of light can be propagated indifferently through ordinary media, it follows that the sphere of influence of the force, or number of molecules taken into account, does not here depend on the arrangement of the molecules of ether in the medium, but on the retardation of one of the vibrations behind the other, or the absence of it, originally impressed on the ray in the respective cases.

A paper was also read, entitled, "An Experimental Inquiry into the influence of Nitrogen on the Growth of Plants." By Robert Rigg, Esq. Communicated by the Rev. J. B. Reade, M.A., F.R.S., &c.

The author, after briefly alluding to a former paper laid before the Royal Society, describing the chemical changes which occur during the germination of seeds, and some of the decompositions of vegetable matter, proceeds, in the present paper, to trace a connexion between the phenomena exhibited during the growth of plants, and the direct agency of nitrogen. The experiments by which the author supports his views are arranged in separate tables, so drawn out as to indicate not only the quantities of carbon, oxygen, hydrogen, nitrogen, and residual matter, in about 120 different vegetable substances, but also the quantity of nitrogen in each compound, when compared with 1000 parts by weight of carbon in the same substance. The most important of these tables are those which exhibit the chemical constitution of the germs, cotyledons and rootlets of seeds; the elements of the roots and trunks of trees, and the characters of the various parts of plants, especially of the leaves, at different periods of their growth. From this extensive series, which is stated to form but a small portion of the experiments made by the author in this department of chemical research, it appears that nitrogen and residual matter are invariably the most abundant in those parts of plants which perform the most important offices in vegetable physiology; and hence the author is disposed to infer, that nitrogen (being the element which more than any other is permanent in its character) when coupled with residual matter, is the moving agent, acting under the living principle of the plant, and moulding into shape the other elements. The method of ultimate analysis adopted by the author, enables him, as he conceives, to detect very minute errors, and therefore to speak with certainty as to the accuracy and value of every experiment.

A paper was also read, entitled, "Researches in Rotatory Motion." By A. Bell, Esq. Communicated by the Rev. W. Whewell, M.A., F.R.S., &c.

This paper, which is altogether analytical, contains several new theorems in rotatory motion, respecting the effect of the centrifugal force arising from a rotation about any axis, in producing rotation

about another, inclined at any angle to the former; and also a new, and comparatively concise, demonstration of the equations of the motion of rotation of a solid body, its centre of gravity being fixed, and the body being acted on by any forces.

The Society then adjourned over Whitsun-week to meet again on the 14th June next.

June 14, 1838.

His Royal Highness the DUKE of SUSSEX, K.G., President, in the Chair.

A paper was read, entitled, "Researches on Suppuration;" by George Gulliver, Esq., Assistant Surgeon to the Royal Regiment of Horse Guards. Communicated by John Davy, M.D., F.R.S., Assistant Inspector of Army Hospitals.

The author, in consequence of some theoretical views of the suppurative process, was led to undertake an examination of the blood in the different forms of fever accompanying inflammation and suppuration; and the result has been the detection of globules of pus in that fluid in almost every instance where there had existed, during life, either suppuration, or great tumefaction of the external parts without the presence of pus. The means by which he detected pus in the blood were partly chemical, and partly by the aid of the microscope. Availing himself of the solvent power which water exerts on the globules of the blood, while it has no action on those of pus, he had merely to dilute the suspected blood sufficiently with water, by which means the red globules were made to disappear, while those of pus remained at the bottom of the fluid, and were easily recognised by a good microscope. A number of cases are detailed, from which the general result, above stated, was deduced. He considers that his experiments tend to establish the conclusion that suppuration is a kind of proximate analysis of the blood. As the fibrin separated from this fluid produces swelling of the part affected, or is attracted to the contiguous tissue for the reparation of the injury, the globules of the blood, altered by stagnation, become useless, and are discharged as excrementitious matter from the system. Such is the constitution of healthy pus: but when mixed with broken down fibrin, it assumes the flaky and curdled appearance, with proneness to putrefaction, characterising unhealthy pus, and the presence of which in the blood is connected with fevers of the inflammatory or typhoid form.

A paper was also in part read, entitled, "Researches on the Tides," Ninth Series; by the Rev. W. Whewell, M.A., F.R.S., &c.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1838. No. 34.

June 21, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

The Treasurer announced from the Chair that a deputation of the Society, consisting of His Royal Highness the President, the Vice-Presidents, Treasurer, Secretaries, and other Members of the Council, waited yesterday on *Her Majesty*, for the purpose of receiving *Her Majesty's* signature in the Charter-book of the Society, as Patroness of the Royal Society, when *Her Majesty* was graciously pleased to inscribe her name accordingly; on which occasion His Royal Highness made the following address:

"May it please your Majesty,

"In obedience to your gracious Commands, the President and the Council of the Royal Society for the promotion of Natural Knowledge now appear in your Royal presence, humbly to tender the register of its Members for the insertion of your august signature.

"Our very name and the recollection of our first institution prompt and encourage us to look up to Your Majesty as our Patron and Protector; and which, by this especial act of your favour, will confirm to the Society the assurance so graciously communicated to us, in your name, by the Secretary of State for the Home Department, in reply to the dutiful Address we had the honour to present to your Majesty on your accession.

"Permit me, Most Gracious Sovereign, to avail myself of this opportunity to express to your Majesty, in the name and on the behalf of the Fellows of the Royal Society, their gratitude for your munificent grant of two Gold Medals annually, for the encouragement of Science in its different branches; and more especially for allowing the Council so to alter for the present year the statute regulating the distribution of them, as to render it available and conformable to the view for which it was framed.

"Peace, Navigation and Commerce, are as necessary to the growth of Literature, as to the intercourse with the Natural World.

"Of these blessings we were already in possession when Your Majesty ascended the Throne of your Ancestors. That such may continue to exist and thrive in this happy country during a long, prosperous, and useful reign, with every other earthly

felicity which Divine Providence in its wisdom may deign to shower down on Your Royal and Sacred Head—is the most ardent wish and fervent prayer of the President, Council, and Fellows of the Royal Society, in unison with all your other loyal subjects."

The following papers were then read, viz.

"On the structure of the teeth, the vascularity of those organs, and their relation to bone." By John Tomes, Esq. Communicated by Thomas Bell, Esq., F.R.S., Professor of Zoology in King's College, London.

The microscopical examinations which the author has made of the structure of the teeth of man and various animals, lead him to the conclusion that their bony portions are formed of minute tubes, disposed in a radiated arrangement, in lines proceeding everywhere perpendicularly from the inner surface of the cavity containing the pulp. These tubuli are surrounded by a transparent material, which cements them together into a solid and dense mass. He finds, by applying the test of muriatic acid, that carbonate as well as phosphate of lime enters into their composition. In man, the tubuli, during their divergence from their origin at the surface of the central cavity, send off a number of very minute fibrils; and on approaching the enamel or the granular substance, which cover respectively the crown and the fangs of the tooth, the tubuli divide into smaller ones, which freely anastomose with one another, and then either are continued into the enamel, or terminate at the boundary between these two substances. Various modifications of this structure, exhibited in the teeth of different animals, in the class Mammalia and Fishes more particularly, are minutely described. The granular substance appears to be composed of irregularly shaped osseous granules, imbedded in the same kind of transparent medium which cements the tubuli together. External to the granular portion, the author finds another substance entering into the formation of the simple tooth, and commencing where the enamel terminates; and which he describes as beginning by a thin and transparent layer containing only a few dark fibres, which pass directly outwards; but assuming, as it proceeds towards the apex of the fang, greater thickness and opacity, and being traversed by vessels.

External to the enamel, and in close connexion with it, in compound teeth, is situated the crusta petrosa, a substance very similar to the bony layer of the simple tooth. It contains numerous corpuscles, and is traversed by numerous vessels entering it from without, and anastomosing freely with one another, but terminating in its substance. These investigations of the structure of the different component parts of teeth, furnish abundant evidence of their vascularity and consequent vitality.

"On the evolution of Nitrogen during the growth of plants, and the sources from whence they derive that element." By Robert Rigg Esq. Communicated by the Rev. J. B. Reade, M.A., F.R.S., &c.

In this communication the author follows up his inquiry into the

influence and importance of nitrogen in vegetable physiology, by noticing, in the first place, the experiments of Dr. Daubeny, M. De Saussure, Sir Humphry Davy, and those which he himself has made; all of which tend to prove that nitrogen is evolved during the healthy performance of the functions of plants; that the proportion which it bears to the oxygen given off is influenced by the sun's rays; but that owing to the necessary exclusion of the external atmosphere during the progress of the experiments, it is impossible, with any degree of accuracy, to calculate the volume of these evolved gases during any period of the growth of plants in their natural state.

If to this indefinite quantity of nitrogen given off by plants there be added that definite volume incorporated into their substance and shown in the author's former tables, the question arises, whence do plants derive their nitrogen, and does any part of it proceed from the atmosphere? A problem which the author proposes to solve by a series of tabulated experiments upon seeds, and seedling plants, indicating a large excess of nitrogen in the latter, and under such circumstances of growth that he is compelled to fix upon the atmosphere as its source.

By the same mode of experimenting, the author attempts to show that the differences which we find in the germination of seeds and the growth of plants in the shade and sunshine, are apparently due in a great measure to the influence of nitrogen. And he concludes by observing, that he does not touch upon the practical application of the subject wherein the real value of the inquiry consists; it is his object to draw attention to an element which, though in some instances so minute in quantity as to be with difficulty detected in our balances, has nevertheless been wisely assigned to discharge the most important functions.

"On the decussation of fibres at the junction of the Medulla Spinalis with the Medulla Oblongata." By John Hilton, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author first alludes to what usually happens in affections of the brain, namely, that the loss of voluntary power and of sensation manifest themselves in the opposite side of the body to that in which the cerebral lesion exists, a fact which has been attempted to be explained by the crossing of the fibres at the junction of the *medulla oblongata* with the anterior or motor columns of the *medulla spinalis*; but such a structure, he observes, affords no explanation of the loss of sensation. The author then, referring to the communication of Sir Charles Bell to the Royal Society, in the year 1835, describing a decussation connected with the posterior columns, or columns of sensation, mentions that the accuracy of these dissections was doubted by Mr. Mayo and other eminent anatomists. The author proceeds to state that the symptoms of cerebral lesion do not always take place on the opposite side of the body to that in which the lesion of the brain exists, but that they occur sometimes on the same side; that the loss of power and of sensation, although confined to the same side, may exist in either the upper or the lower extremity;

but that both are not necessarily implicated; and that, in fact, cases occur where there are marked deviations from what may be considered the more common occurrence. Having observed such cases, and not being aware of any satisfactory explanation, the author examined with care the continuation upwards of the anterior and posterior columns of the spinal marrow into the *medulla oblongata* and found that the decussation at the upper part of the spinal marrow belonged in part to the columns for motion, and in part to the columns for sensation; and farther, that the decussation is only partial with respect to either of these columns; thus elucidating by the observation of the actual structure what before appeared very unsatisfactory in pathology, and anomalous in disease.

The paper is illustrated by drawings made from the dissections of the author.

"Description of a self-registering Thermometer and Barometer invented by the late James Coggan, Esq., and bequeathed by him to the Royal Society." By Roderick Impey Murchison, Esq., F.R.S., V.P.G.S., &c.

The self-registering thermometer used by Mr. Coggan is of Six's construction, and consists of a siphon tube, open at one extremity, and operating by the expansion and contraction of a large body of spirit pressing on a column of mercury in the lower bend of the tube. On the other side of the wooden frame to which this thermometer is fixed, a siphon barometer is attached; and both these instruments are made to act on iron-floats suspended by a thread, and counterpoised over a pulley. Transverse wires are affixed to these threads, and are forced against a sheet of ruled paper on a frame, which from its connexion with a clock is advanced a certain space each day, by a spring hammer forming part of the striking machinery of the clock.

"On the action of light upon the colour of the River Sponge." By John Hogg, M.A., F.L.S., C.P.S., &c., Fellow of St. Peter's College, Cambridge. Communicated by Thomas Bell, Esq., F.R.S.

The author found that the green colour of the *Spongilla fluviatilis*, or river sponge, is acquired solely through the agency of light, and is lost when the sponge is removed from its influence. As this does not appear to be the case with Actiniæ, the Hydra viridis, or any other Polype, the author is disposed to consider this production as being nearer allied to the Algæ or Fungi, than to any tribe belonging to the animal kingdom.

"Researches on the Tides. Ninth Series. On the deduction of the Laws of the Tides, from short Series of Observations." By the Rev. W. Whewell, M.A. Trin. Coll., Cambridge.

It is very desirable to ascertain whether it is possible to deduce the laws of the tides from short series of observations; since, if it be so, not only does the construction of good tide tables for different places become more easy; but also the value of tide tables is much increased, if the predicted tides agree with those of each year as well as with the mean of many years. The object of the author

in the present paper is to determine this point by the discussion of several years' observations of the tides at Plymouth and at Bristol. The calculations for the former place were executed by Mr. Dessiou and Mr. Ross in the Hydrographer's Office at the Admiralty; the calculations for Bristol were performed by Mr. Bunt, in virtue of a grant of money from the British Association. The result of these discussions is, that a very regular form and good approximation for the semimenstrual inequality may be obtained from the observations of one year; that the existence of the lunar parallax corrections appears very clearly in the observations of one year; and that its value may be determined from a series of three or four years. The lunar declination corrections are more irregularly given by short series of observations; but in a series of four or five years, the general form and approximate value of the corrections become manifest. In the course of these calculations such questions as the following were proposed, and their solution attempted: 1. To which transit of the moon ought we to refer the tide? It appears that the transit which produces the best accordance with theory, is that which Mr. Lubbock terms transit B, which is an epoch about 42 hours anterior to the high water at Bristol and Plymouth. 2. How does a change of the epoch affect, first, the semimenstrual inequality; secondly, the parallax correction of the time; thirdly, the declination correction of the times; fourthly, the parallax correction of heights; and fifthly, the declination correction of the heights? 3. Does the parallax corrections of height vary as the parallax? 4. Does the parallax correction of time vary as the parallax? 5. Does the declination correction of the heights vary as the square of the declination? 6. Does the declination correction of time vary as the square of the declination? 7. Can the laws of the corrections be deduced from a single year? 8. Are there any regular differences between the corrections of successive years? 9. Do the corrections at different places agree in themselves? It does not appear that any change of the epoch will produce an accordance of the observed laws with the theory, some of the inequalities requiring one epoch for this purpose, and some requiring another. The inequalities in different years and different places are also compared.

Mr. Whewell remarks, that since it has now been shown that good tide tables may be obtained from short series of observations, his researches with regard to the determination of the lunar corrections may be concluded; and the proper mode of farther prosecuting the subject, would be to have tide observations at several stations, each observatory reducing its own observations, and thus constantly improving the tables, as is practised in other branches of Astronomy.

"Researches in Embryology." *First Series*. By Martin Barry, M.D., F.R.S.E., Fellow of the Royal College of Physicians in Edinburgh. Communicated by P. M. Roget, M.D., Sec. R.S.

This paper is divided into two parts. In the first part the author describes the origin and structure of the ovisac, a vesicle common

to all vertebrated animals, but hitherto regarded as the inner membrane of the "folliculus Graafianus" in Mammalia, and by some authors denominated the "chorion" in other Vertebrata. He also describes the real nature of the "folliculus Graafianus," and its relation to the calyx of the Bird; the germinal vesicle and its contents, as being the most primitive portion of the ovum; the order of formation of the several other parts of the ovarian ovum; and the true chorion of Mammalia as being a structure superadded within the ovary.

In the second part the author describes a granulous tunic of the ovum of Mammalia not hitherto observed; the manner of origin of the "membrana granulosa" of authors; the different situations of the ovum in the Graafian vesicle at certain periods *ante coitum*, not hitherto observed; and certain structures by means of which the ovum is made to occupy these several situations.

The following are the principal facts made known by Dr. Barry in this memoir; but other facts are also mentioned, which he intends to make the subject of a future communication. In Mammalia and in Birds the germinal vesicle and its contents are those parts of the ovum which are first formed. The germinal vesicle at an early period is surrounded by peculiar granules, forming an envelope not hitherto described. The ovum of all vertebrated animals is contained in a vesicle (the "chorion" of some authors, found in Birds, Amphibia, and Fishes), which is essentially the same in structure wherever found, and which he thinks it desirable universally to denominate an *ovisac*. This vesicle is the "couche *interne*" of the Graafian vesicle, as described by Professor Baer. The Graafian vesicle of Mammalia is nothing more than an ovisac that has acquired a covering or tunic, susceptible of becoming highly vascular, which covering is the "couche *externe*" of the Graafian vesicle as described by Baer. The ovisac of Birds, Amphibia, and Fishes ("chorion" of some authors), acquires in like manner a covering or tunic, susceptible of becoming highly vascular; and by the union of the ovisac with this covering, there is constituted a structure analogous to the Graafian vesicle of Mammalia. The quantity of yelk in the former being large, that portion of the ovary which contains the structure here referred to (as analogous to the Graafian vesicle of Mammals) becomes pendent; and now the united coverings of the yelk-ball,—viz. the ovisac, its external tunic, the ovarian stroma, and the peritoneal investment,—are together called the *calyx*. From this it will be obvious that the Graafian vesicle is not a structure peculiar to Mammalia, as it has been supposed.

The ovisac has at first an elliptical or ellipsoidal form, becomes more spherical, and in Mammalia is often met with somewhat tapered at one end. The structure of the ovisac in some of the Mammalia may be examined when it does not exceed in length the 50th or even the 100th part of a Paris line, that is, in the latter case, the 1125th of an English inch. Myriads of ovisacs with their contents are formed that never reach maturity. Some of the ovisacs which do not reach maturity are situated in the parietes of Graafian

vesicles in Mammalia, or of the corresponding structures in other Vertebrata; being sometimes formed in this situation, and sometimes included within the covering which the larger ovisac acquires. The minute ovisacs so situated the author proposes to denominate *parasitic* ovisacs. The ovisac is often found in a cavity proper to itself, with the walls of which it has no organic union. The granules forming the envelope of the germinal vesicle above referred to, and subsequently found in the fluid of the ovisac, are very peculiar in their appearance, contain a nucleus, and sometimes also a pellucid fluid, and are intimately connected with the evolution of the ovum. These granules are present in largest quantity in the ovisac of Mammalia; yet granules essentially the same exist in an early stage in the ovisac of Birds, and are sometimes met with in that of Fishes.

A continual disappearance of ova, and a formation of others, are observable even at a very early age. The ovum of Mammalia when completely formed is at first situated in the *centre* of the ovisac. It is at this period supported in the centre of the ovisac by an equable diffusion of granules throughout the fluid of the latter. The ovisac about the same time begins to acquire a covering or tunic, by which addition, as already stated, there is constituted a Graafian vesicle; and of the latter, the ovisac is now the inner membrane. After this period, then, it is proper to speak, not of an ovisac, but of a Graafian vesicle. The peculiar granules of the Graafian vesicle arrange themselves to form three structures, viz. the *membrana granulosa* of authors, and two structures not hitherto described, one of which the author proposes to name the *tunica granulosa*, and the other, which is rather an assemblage of structures than a single structure, the *retinacula*. The tunica granulosa is a spherical covering proper to the ovum, and its presence explains why the outer line in the double contour of the thick chorion has remained so long unobserved. At a certain period this tunic, in some animals at least, is seen to have tail-like appendages, consisting of granules similar to its own. The retinacula consist of a central mass containing the ovum in its tunica granulosa, and of cords or bands extending from this central mass to the membrana granulosa. These structures at a certain period became invested by a membrane. The offices of the retinacula appear to be,—first, to suspend the ovum in the fluid of the Graafian vesicle,—next, to convey it to a certain part of the periphery of this vesicle,—and subsequently to retain it in the latter situation, and also to promote its expulsion from the ovary. The particular part of the periphery of the Graafian vesicle to which the ovum is conveyed, is uniformly that directed towards the surface of the ovary. The mass of granules escaping with the ovum on the bursting of a Graafian vesicle under the compressor, is composed chiefly of the tunica granulosa and the ruptured retinacula. The "cumulus" of Professor Baer is made up of the parts called by Dr. Barry the tunica granulosa and the central portion of the retinacula; and the band-like portions, collectively, of what Dr. Barry calls the retinacula, mainly contribute to produce the appearance denominated the "flat disc" by Professor Baer.

In Mammalia a thick and highly transparent membrane,—the true chorion,—is formed external to the proper membrane of the yelk, while the latter is in the ovary. The inner part of the substance of the chorion in its early stages is in a fluid state, so that the yelk-ball moves freely in it; but it subsequently acquires more consistence. There is not any structure corresponding to the chorion in the *ovary* of other vertebrated animals.

The following appears to be the order of formation, as to time, of the more permanent parts of the ovum and the Graafian vesicle in Mammalia, viz.:

1. The germinal vesicle, with its contents, and its envelope of peculiar granules.
2. The proper membrane of the ovisac, which forms around this envelope of granules.
3. The yolk, which forms around the germinal vesicle.
4. The proper membrane of the yolk, which makes its appearance while the yolk is still in an incipient state.
5. The chorion.
6. The covering or tunic of the ovisac; and about the same time, the peculiar granules of the ovisac arrange themselves to form,
   - The tunica granulosa,
   - The retinacula, and
   - The membrana granulosa.

Such of these structures as are present in the ovary of other Vertebrata, appear to originate in the same order as to time.

"Contributions to the Physiology of Vision." By Charles Wheatstone, Esq., F.R.S., Professor of Experimental Philosophy in King's College, London. *Part the First.* "On some remarkable and hitherto unobserved Phenomena of Binocular Vision."

The author first shows that the perspective projections of an object upon the two retinæ differ according to the distance at which the object is placed before the eyes; if it be placed so distant that to view it the optic axes must be parallel, the two projections are precisely similar; but if it be placed so near that to regard it the optic axes must converge, a different perspective projection is presented to each eye; and these perspectives become more dissimilar as the convergence of the optic axes becomes greater. Notwithstanding this dissimilarity between the two pictures, which is in some cases very great, the object is still seen single; contrary to the very prevalent metaphysical opinion, that the single appearance of objects seen by both eyes is owing to their pictures falling on corresponding points of the two retinæ. After establishing these principles, the author proceeds to ascertain what would result from presenting the two monocular perspectives, drawn on plane surfaces, to the two eyes, so that they shall fall on the same parts of the two retinæ as the projections from the object itself would have fallen. Several means are described by which this may be accomplished; but the author especially recommends for this purpose an apparatus called by

him a *stereoscope*, which enables the observer to view the resulting appearances without altering the ordinary adaptation of the eyes, and therefore without subjecting these organs to any strain or fatigue. It consists of two plane mirrors with their backs inclined to each other at an angle of 90°, near the faces of which the two monocular pictures are so placed that their reflected images are seen by the two eyes, one placed before each mirror, in the same place; the apparatus has various adjustments by means of which the magnitude of the images on the retinæ may be varied, and the optic axes differently converged. If the two monocular pictures be thus presented one to each eye, the mind will perceive, from their combined effect, a figure of three dimensions, the exact counterpart of the object from which the pictures were drawn; to show that this curious illusion does not in the least depend on shading or colouring, the illustrations principally employed are simple outline figures, which give for their perceived resultants skeleton forms of three dimensions. Each monocular outline figure is the representation of two dissimilar skeleton forms, one being the form which it is intended to represent, and another, which Prof. Wheatstone calls its converse figure Viewed by one eye alone the outline may with equal ease be imagined to be either; but when the two monocular pictures are viewed one by each eye, the proper or the complemental form may be fixed in the mind; the former, if the right and left pictures be presented respectively to the right and left eyes; and the latter, if the right picture be presented to the left eye, and the left picture to the right eye. Many new experiments are then detailed, and a variety of instances of false perception of visual objects, some new, others formerly observed, are traced to these principles; among others, the well-known apparent conversion of cameos into intaglios. The author next proceeds to show that pictures similar in form but differing in magnitude within certain limits, when presented one to each eye, are perceived by the mind to be single and of intermediate size; and also that when totally dissimilar pictures, which cannot be combined by the mind into the resemblance of any accustomed objects, are presented one to each eye, they are in general not seen together, but alternately. The memoir concludes with a review of the various hypotheses which have been advanced to account for our seeing objects single with two eyes; and the author states his views respecting the influence which these newly developed facts are calculated to have on the decision of this much debated question.

"Experimental Researches in Electricity," *Fourteenth Series.*

On the general nature and relation of the Electric and Magnetic Forces. By Michael Faraday, Esq., D.C.L., F.R.S., &c. &c.

The author commences by observing that the theory of electrical induction, which he had set forth in the 11th, 12th, and 13th series of researches, does not assume or decide anything as to the real nature of the electric forces, but only as to their distribution; the great question respecting the existence of any electric fluid, or of one, or of two fluids remaining untouched. He then states what

the theory does assume; as, for instance, that all *particles*, whether of insulators or conductors, are, as *wholes*, conductors; that, being conductors, they can readily be charged either bodily or polarly; that contiguous particles being on the line of inductive action can communicate their forces more or less readily; that those doing so most readily constitute the bodies called *conductors*, and those doing so least readily those called *insulators*, &c.

Having thus given a brief summary of the conclusions drawn from the previous investigations, the author proceeds to consider the particular condition of the particles which, in an insulating body, are considered as polarized; and after showing that the theory requires that they should be able to polarize in any direction, he states his expectation that a greater facility to polarize in one direction than another would still be found to belong to them, and proceeds experimentally to determine this point. His experiments were made by observing the degree of inductive force across cubes of perfectly crystallized bodies, as rock crystal and Iceland spar; these being cut so as to have the axis of the crystal parallel to the line joining two opposite faces of the cube; but the experiments, which are laborious, require extension, and he has not as yet been able to prove or disprove the expected result.

The author then considers whether in compound bodies it is the ultimate and elementary particles or the compound particles which polarize as wholes. He concludes that it is the latter which assume that state; and shows how this point bears upon the electrolyzation of such bodies as are separated into simpler substances, or otherwise altered by the action of the voltaic current.

He then proceeds to certain experiments bearing upon the nature of the relation of the electric and magnetic forces, giving his view of the character of this relation; and concludes his paper by briefly stating what he thinks is more satisfactorily explained by the theory which refers inductive action to an action of contiguous particles than by the old theory.

"Experiments on the Vibration of the Pendulum." By W. J. Frodsham. Communicated by Francis Beaufort, Capt. R.N., F.R.S.

The object of this paper is to show the advantages that may result from attaching to the top of the pendulum a brass tube, which the author terms "an isochronal piece," about five inches in length, fitting the pendulum very nicely, and slit so as to form a spring for about an inch at the bottom, sliding rather stiffly on the rod, so that its position, and consequently its influence on the action of the pendulum, may be varied at pleasure; and that unequal arcs of vibration may be made to correspond to equal intervals of time.

"An Account of some Experiments on the Blood in connexion with the Theory of Respiration." By John Davy, M.D., F.R.S., Assistant Inspector of Army Hospitals.

The author has investigated, experimentally, several of the important questions connected with the theory of respiration and of

animal heat; and arrives at the following results. He finds that the blood is capable of absorbing oxygen both from atmospheric air, and from oxygen gas, independently of putrefaction. After blood has been agitated in common air, a trace of carbonic acid, not exceeding one per cent., is found in the residual air; but when pure oxygen is employed, no carbonic acid can be detected in it by the most carefully conducted trials. When pure carbonic acid is brought into contact with blood, or serum, over mercury, and moderately agitated, the absorption of gas exceeds the volume of the fluid. Both arterial and venous blood are rendered very dark, and serum more liquid by the absorption of this gas to saturation. Serum, in its healthy state, is incapable of absorbing oxygen, or of immediately furnishing carbon to form carbonic acid: and after it has absorbed carbonic acid, only one-tenth of the absorbed gas is expelled by successive agitation with atmospheric air, or with hydrogen. The author is inclined to think that the alkali in the blood, in its healthiest condition, is in the state of a sesquicarbonate. In the majority of trials manifest indications of the disengagement of air from blood *in vacuo* were obtained: but as it occasionally happened that no air could be thus extricated, the author is induced to believe that the quantity of air contained in the blood is variable: and he has found this air to consist solely of carbonic acid gas. It would also appear, from the experiments detailed in this paper, that a portion of oxygen exists in the blood, not capable of being extracted by the air-pump, yet capable of entering into combination with nitrous gas; and existing in largest proportion in arterial blood. The absorption of oxygen by blood is attended with an increase of temperature.

The experiments of the author tend to show that the lungs are absorbing and secreting, and perhaps also inhaling organs, and that their peculiar function is to introduce oxygen into the blood and separate carbonic acid from the blood: and they favour the idea that animal heat is owing, first, to the fixation or condensation of oxygen in the blood in the lungs during its conversion from venous to arterial; and secondly, to the combinations into which it enters in the circulation in connexion with the different secretions and changes essential to animal life.

"On the Geometrical Forms of Turbinated and Discoid Shells." By the Rev. H. Moseley, Professor of Natural Philosophy and Astronomy in King's College, London. Communicated by Thomas Bell, Esq., F.R.S.

This paper is occupied by an investigation of certain mathematical principles which the author considers as governing the formation of turbinated and discoid shells. According to these views, all such shells may be conceived to be generated by the revolution about a fixed axis of the perimeter of a geometrical figure, which, remaining always similar to itself, increases continually its dimensions. The spiral lines which are observable on the opercula of certain classes of shells, taken in connexion with the well-known properties of the

logarithmic or equiangular spiral, appear to have suggested the idea, that not only the boundary of the operculum, which measures the sectional expansion of a shell, but also the spiral lines, which in general are well marked both externally and internally in the shell itself, are curves of this nature.

From an examination of the spirals marked on opercula, it appears that the increase of their substance takes place on one margin only; the other margin still retaining the spiral form, and acquiring an increase of length by successive additions in the direction of the curve. As in the logarithmic spiral the distances of successive spires, measured on the same radius vector produced from the pole, from each other, are respectively in geometrical progression, if similar distances between the successive whorls on the opercula of shells be found to observe the same law, it will follow that these whorls must have a similar form; and that such is the case, the author shows by a variety of numerical results obtained by careful measurements on three different opercula of shells of the order *Turbo*. That such is the law of nature in the formation of this class of shells is rendered probable by the instances adduced by the author, in which a conformity to this law is found to exist.

From the known properties of the logarithmic spiral the author concludes that the law of the geometrical description of turbinated shells is, that they are generated by the revolution about a fixed axis, (namely, the axis of the shell,) of a curve, which continually varies its dimensions according to the law, that each linear increment shall vary as the existing dimensions of the line of which it is the increment. If such be the law of nature, the whorls of the shell, as well as the spires on the operculum, must have the form of the logarithmic spiral; and that this is likewise the case is shown by the almost perfect accordance of numerical results, deduced from the property of that curve, with those deduced from a great variety of careful measurements made of the distances between successive whorls on radii vectores drawn on shells of the *Turbo duplicatus*, *Turbo phasianus*, *Buccinum subulatum*, and in a fine section of a *Nautilus pompilius*. The author further states that, besides the results given in the paper, a great number of measurements were similarly made upon other shells of the genera *Trochus*, *Strombus*, and *Murex*, all confirmatory of the law in question.

One of the interesting deductions which the author has derived from the prevalence of this law in the generation of the shells of a large class of mollusca, is that a distinction may be expected to arise with regard to the growth of land and of aquatic shells, the latter serving both as a habitation and as a float to the animal which forms it; and that, although the facility of varying its position at every period of its growth may remain the same, it is necessary that the enlargement of the capacity of the float should bear a constant ratio to the corresponding increment of its body; a ratio which always assigns a greater amount to the increment of the capacity of the shell than to the corresponding increment of the bulk of the animal.

Another conclusion deducible from the law of formation here con-

sidered is, that the growth of the animal, corresponding to a given increment in the angle of the generating curve, will always be proportional to the bulk it has then attained: and if the physical vital energies of the animal be proportional to its actual bulk, its growth, in any given time, will be proportional to its growth up to that time. Hence the whole angle of revolution of the curve generating the shell will be proportional to the whole corresponding time of the animal's growth; and therefore, the whole number of whorls and parts of whorls will, at any period, be proportional to its age.

The form of the molluscous animal remaining always similar to itself, the surface of the organ by which it deposits its shell will vary as the square of the linear dimensions; but as the deposition of its shell must vary as the cube of the same dimensions, there must be an increased functional activity of the organ, varying as the simple linear dimensions.

Since to each species of shell there must correspond a particular number expressing the ratio of the geometrical progression of the similar successive linear dimensions of the whorls; and since the constant angle of the particular logarithmic spiral, which is affected by that species of shell, is deducible from this number, the author considers that, connected as the form of the shell is with the circumstances of the animal's growth and the manner of its existence, this number, or the angle of the particular spiral, determinable as it is in each case by actual measurement, may be available for the purposes of classification, and may suggest relations by which, eventually, they may become linked with characteristic forms, and modes of molluscous existence.

The concluding portion of the paper contains a mathematical discussion of certain geometrical and mechanical elements of a conchoidal surface. These are, the extent of the surface itself; the volume contained by it; the centre of gravity of the surface, and also of the volume, in each case, when the generating figure revolves about a fixed axis without any other motion, and also when it has, besides this, a motion of translation in the direction of that axis; and, lastly, the angle of the spiral. The author states that his object in this inquiry is the application of these elements to a discussion of the hydraulic theory of shells. The constant angle of the spiral, which each particular species affects, being connected by a necessary relation with the economy of the material of the habitation of each, with its stability, and the condition of its buoyancy, it is therefore necessary to determine the value of this angle.

"On the relative attractions of Sulphuric Acid for water, under particular circumstances: with suggestions of means of improving the ordinary process of manufacturing Sulphuric Acid." By Henry Hugh Watson, Esq., Corresponding Member of the Manchester Philosophical Society. Communicated by John Dalton, D.C.L., F.R.S., &c.

The object of the inquiry detailed in the present paper is to determine at what degree of concentration the affinity of sulphuric

acid for aqueous vapour is equal to that of anhydrous space for the same vapour at given temperatures. It has long been known that concentrated sulphuric acid abstracts moisture from the atmosphere, but the amount and the rate of this absorption have never been ascertained with accuracy; and consequently, in applying this acid to purposes of exsiccation, the experimenter has often been at a loss to know whether the acid was sufficiently strong to render the space in which it was confined perfectly anhydrous. By placing portions of the acid, previously weighed, and diluted with known quantities of water, under the receiver of an air-pump, with equal portions of concentrated acid, of the specific gravity 1·8428, in similar dishes, the author ascertained that the dilute acid could be concentrated to the specific gravity 1·814, at a temperature varying from 65° to 57°: whence he concludes that acid of such strength is capable of drying a vacuum when the temperature does not exceed 57°. By making similar experiments in air, the author compared together the weights lost by ten grains of dilute sulphuric acid of the specific gravity 1·135, at three different periods of the day for six days, taking note of the dew-point and the temperature; and infers that when the affinity of space for vapour, or the evaporating force, is equal to 0·15 of an inch of mercury, it is just able to balance the affinity for water of sulphuric acid of the specific gravity 1·249.

The author next instituted a series of experiments to ascertain whether the evaporation of water from dilute sulphuric acid is capable of being carried on to the same extent in air as in vacuo, and found that the evaporating force of air exerted upon such acid is less than that of a vacuum at the same temperature. He observes that his experiments offer conclusive evidence that the evaporation of water is not owing to the existence of a chemical affinity between the vapour of the liquid and atmospheric air; but thinks that they favour the notion that the obstruction to this process in the open atmosphere is rather owing to the pressure than to the *vis inertiæ* of the particles of air. He is also of opinion that improvements will hereafter arise from this inquiry with regard to the economical management of the process of manufacturing sulphuric acid, which process would be greatly expedited by the regulated admission of steam into the condensing chambers kept at a constant high temperature.

The Society then adjourned over the long vacation to meet again on the 15th of November next.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1838. No. 35.

November 15, 1838.

DAVIES GILBERT, Esq., V.P., in the Chair.

The following gentlemen were, by ballot, elected Auditors of the Treasurer's accounts, on the part of the Society, viz., Thomas Galloway, Esq., Thomas Graham, Esq., Sir John F. W. Herschel, Bart., M.A., John W. Lubbock, Esq., M.A., and the Rev. Adam Sedgwick, M.A.

Monck Mason, Esq., was balloted for, but not elected into the Society.

A paper was read, entitled, "Discovery of the Source of the Oxus." By Lieut. Wood, of the Indian Navy. Communicated by James Burnes, K.H., D.C.L., F.R.S., in a letter to the Secretary of the Royal Society.

The following notice of the discovery of the source of the Oxus by Lieut. Wood, one of the officers serving under Captain Alexander Burnes, F.R.S., in his political and scientific mission to Cabul, is contained in a letter from Captain Burnes:

"This celebrated river" (the Oxus) "rises in the elevated region of Pameer in Sinkoal. It issues from a sheet of water, encircled on all sides, except the west, by hills, through which the infant river runs; commencing its course at the great elevation of about 15,600 feet above the level of the sea, or within a few feet of the height of Mont Blanc. To this sheet of water Lieut. Wood proposes to assign the name of *Lake Victoria*, in honour of Her Majesty."

November 22, 1838.

FRANCIS BAILY, Esq., V.P. and Treas., in the Chair.

Lieut.-General John Briggs, E.I.C.S., was balloted for, and duly elected into the Society.

A paper was read, entitled, "On the State of the Interior of the Earth." By W. Hopkins, Esq., M. A., F.R.S., F.R.A.S., &c.

The object of the present memoir is to inquire into the modes in which the refrigeration of the earth may have taken place, on the

hypothesis that its entire mass was originally in a fluid state; an hypothesis which was at first founded on astronomical considerations, and is now corroborated by the discoveries of modern geology, exhibiting the apparent injection from below of large masses of unstratified rocks, through the fissures of sedimentary strata. Assuming that this state of fluidity was the effect of heat, we are led to consider the steps of transition by which the earth has passed into its present state of solidity, and apparently permanent temperature. After adverting to the analytical investigations of Fourier and Poisson on this subject, the author proceeds to inquire into the results of the laws of refrigeration of heated bodies, which may be conceived to operate in the present case; namely, refrigeration by *circulation*, which obtains when the fluidity is perfect, and that by *conduction*, when the particles of the mass, by the diminution of fluidity, no longer retain that mobility among one another which is requisite for their circulation. Thus while, in either case, the superficial parts of the earth would rapidly cool and solidify by the radiation of their heat into sidereal space, forming a crust of small thickness compared with the whole radius of the globe, the internal mass may be in one or other of the three following conditions:—*First*, it may consist of matter still in a state of fusion, of which both the temperature and the fluidity are greatest at the centre, but which has been brought, by the long-continued process of circulation, into a state no longer admitting of this process, and capable, therefore, of cooling only by conduction. *Secondly*, the earth may consist of an external shell, of a central nucleus, rendered solid by the enormous pressure to which it is subjected, and of an intermediate stratum of matter in a state of fusion. The thickness of the shell, as well as the radius of the solid nucleus, may possibly be small compared with the radius of the earth. The fluidity of the intervening mass must necessarily be here, also, considerably more imperfect than that which would just admit of cooling by circulation. *Thirdly*, the earth may be solid from the surface to the centre.

The author then shows that the direct investigation of the manner in which the earth has been cooled, assuming its original fluidity from heat, cannot determine the actual condition of its central parts, not from any imperfection in the analytical process, but from the want of the experimental determination of certain values, which it is extremely difficult, if not impossible, accurately to obtain. It has occurred to the author that a more indirect test of the truth of the hypothesis of the central fluidity of the earth might be found in the delicate but well-defined phenomena of precession and nutation. The investigation of the problems thus suggested is reserved by the author for the subject of a future memoir.

November 30, 1838.

Francis Baily, Esq., V.P. and Treasurer, in the Chair.

At the Anniversary Meeting of the Royal Society, Mr. Galloway,

one of the Auditors of the Treasurer's accounts on the part of the Society, reported that the balance in the hands of the Treasurer was 1463*l.* 14*s.* 5*d.*

The thanks of the Society were voted to the Treasurer for his past services, and to the Auditors for their trouble in auditing his accounts.

The following list of Fellows deceased, and also of Fellows admitted since the last Anniversary, was read:

Deceased since printing the List, November 1837.

Battine, William, LL.D.
Camac, William.
Carrington, Lord.
Carstairs, John.
Catton, Rev. Thomas.
Colebrooke, Sir James Edward, Bart.
Collingwood, G. L. N., Esq.
Cooke, John, M.D.
Earle, Henry.
Eldon, Earl of.
Elford, Sir William.
Farnborough, Charles, Lord.
Hall, Sir John, Bart.
Hoare, Sir Richard C., Bart.
Holford, Robert.
Hume, Sir Abraham, Bart.
Knight, Thomas A., Esq.
Maccaulay, Zachary, Esq.
Morris, George P., M.D.
Nicholl, Rt. Hon. Sir John.
Selsey, Henry J., Lord.
Taunton, Richard, M.D.
Thomson, Sir John D.
Tomline, William Edward, Esq.
Vay de Vaja, Baron Nicholas.
Williams, John L., Esq.
Woolmore, Sir John.

Foreign Members.

Bowditch, Dr. N.
Cuvier, F.
Dulong, P. L.
Marum, M. van.

New Members.

Arnott, Neill, M.D.
Bateman, James, Esq.
Briggs, General John.
Burnet, Rev. Thomas, D.D.
Carnac, Sir James R.
Cureton, Rev. William, M.A.
Denison, William Thomas, Esq., Lt. R.E.
Donkin, Bryan, Esq.
Eastlake, Charles Lock, Esq.
Glynn, Jos., Esq.
Hansler, Sir John.
Hardwick, John, Esq.
Hymers, Rev. John.
Jervis, Major Thomas Best.
Johnson, Rev. George Henry S.
Johnston, John F. W., Esq.
Locke, Jos., Esq.
Macneill, John, Esq.
MacGillivray, Simon, Esq.
Merewether, Rev. John.
Miller, William Hallows, Esq.
Outram, Benjamin F., M.D.
Pereira, Jonathan, Esq.
Porter, George Richardson, Esq.
Reade, Rev. Jos. B., M.A.
Stirling, Edward Hamilton, Esq.
Todd, Robert B., M.D.
Tuson, Edward William, Esq.
Tweedie, Alexander, M.D.
Twiss, Travers, Esq.
Tuscany, Grand Duke of.
Wilson, Alexander, Esq.

Re-elected.

Hay, Colonel Andrew Leith. | Lowe, George, Esq.

It was stated that the report of the death of R. Z. Mudge, Capt. R.E., noticed at the last Anniversary, has been since found to be erroneous.

The following Address of His Royal Highness the President was read from the Chair:

GENTLEMEN,

I CANNOT quit the Chair of the Royal Society, which I have now occupied during a period of eight years, without availing myself of the opportunity which the customary proceedings of the Anniversary afford me, of expressing to you the grateful sense I entertain of the great honour conferred upon me, by being chosen to fill so distinguished an office, as likewise of the uniform kindness and support which I have always received from the Members of the Council and the Fellows of the Society generally, in the discharge of its various and important duties.

A review of my conduct during the period of my Presidency, recalls to my mind many occasions in which I am sensible that I have been more or less wanting in the very responsible trust confided to me, of watching over the interests of a Society most justly illustrious by the succession of great men who have been connected with it and by the great advances which nearly every department of science has received from those portions of their labours which are recorded in its Transactions; for *some* of these deficiencies I am unfortunately enabled to refer to the severe and long continued visitations of disease and infirmity under which I have laboured, as a very sufficient apology; and I feel less oppressed than I otherwise should have been, by my consciousness of many others, by my knowledge of the activity and zeal of the very able and efficient officers upon whom the temporary discharge of my duties devolved, and from the assurance which I felt, that the interests of the Society, when entrusted to their care, would suffer no detriment by my absence.

Though justly proud of the distinction of presiding over the Royal Society, and most anxious to promote, to the utmost of my power, the great objects for which it was founded, I no sooner ascertained that circumstances would probably, for a time, interfere with my residence in London, during a considerable part of its Annual Session, and prevent my receiving its Members in a manner compatible with my rank and position in this country, than I determined to retire from an office whose duties I could no longer flatter myself as likely to be able to discharge in a manner answerable to their expectations, or in accordance with my own feelings. Having come to this conclusion after the most anxious and painful consideration, I deemed it due to the Members of the Council, in the first instance, and next to the Fellows, to make it speedily and generally

known, with the view of enabling them to look out for a proper person to fill a situation of such dignity in the scientific world, and whose occupation could not fail to be an object of honourable ambition to men of the most eminent social rank, as well as of the most distinguished scientific attainments.

I will not attempt to disguise from you, Gentlemen, the feelings of deep and poignant regret I experienced upon taking a step that would thus necessarily abridge the opportunities, which I had as much enjoyed as I had highly prized, of being brought officially into frequent and familiar contact with the most distinguished philosophers of my own or other countries, and of employing whatever influence my station in society enabled me to exert in advocating the just claims and interests of men of science, in promoting the objects of their labours, in fostering and encouraging their mutual co-operation and intercourse, and in endeavouring to soothe the violence of personal or national jealousies, whenever they unfortunately existed, by bringing them together in social or other meetings where the discussion of topics of irritation could be either suppressed or controlled, and where imaginary prejudices would disappear under the softening operation of reciprocal knowledge and experience. But though deprived for a season, by my retirement, of some of the highest privileges I have hitherto exercised and enjoyed, yet I do not abandon the hope of being still able to maintain and cultivate the very valuable and delightful friendships which I have thus fortunately for myself been enabled to form during the period of my connection with you, by seizing every occasion when presented to me, of appearing at the meetings of the Royal Society, and by co-operating with its members, to the utmost extent of my limited means, in furthering those objects that may be considered to be most important for the advancement of the interests of science.

I am afraid however, Gentlemen, that I have already trespassed unreasonably upon your time and attention in endeavouring to explain to you the motives of my conduct, and to express, though most inadequately, my grateful sense of the kindness which I have invariably experienced from you. I shall therefore now proceed to the more immediate subject of this Address, which is to notice some of the most important Proceedings of the Society which have taken place during the last year.

The Address voted to Her Majesty by the President and Council of the Royal Society, on the Queen's accession to the throne, embodying likewise a petition to Her Majesty to become the Patron of the Society, and to continue to it the Grant of the Medals which had been instituted by King George the Fourth and regranted by William the Fourth, as well as the gracious reply of the Sovereign, transmitted through the Secretary of State for the Home Department, have been already communicated to you at one of the weekly meetings of the Society*. On the 20th of June last, the President and Council were summoned to attend at the Palace of

* June 21, 1838.

St. James's to witness Her Majesty's signature in our Charter-Book as Patron of the Society. I availed myself of the occasion thus presented to me to address the Queen in your name, and to assure Her Majesty that we felt bound by the obligations of our Charter, as well as by the recollection of our foundation, to look up to the Sovereign of these realms as our Patron and protector: that we most gratefully acknowledged the assurances which Her Majesty had conveyed to us through Her minister the Secretary of State for the Home Department, of the continuance of the same support and favour as had been always accorded to us by the Sovereigns of this Kingdom, and likewise the signification of Her Majesty's intention of renewing the grant of the two Medals which had been instituted by one and confirmed by another of Her Majesty's royal uncles and predecessors, accompanied by Her gracious permission to propose such modification and amendments in the statutes which had been provided for their distribution, as would tend most effectually to promote the advancement of science, and would most certainly accomplish the liberal and patriotic views and intentions of their Royal Founders. I further ventured to advert to the close connection which exists between the cultivation of Science and the Arts, and the progress and developement of the great elements of the prosperity and happiness of nations, and to express my earnest hope and prayer that the triumphs of the arts of peace and commerce, which had so signally marked the beginning of Her Majesty's reign, might be continued without intermission to its distant conclusion.

The Queen having received the Address in the most gracious manner, was pleased to sign her august and royal name in our Charter-Book as Patron of the Royal Society: after which the officers and different members of the Council were presented by me to Her Majesty, and had the honour of kissing Her Majesty's hand.

The alterations in the laws for the distribution of the Royal Medals, which Her Majesty was graciously pleased to authorize and permit, have been made by a Committee of the Council appointed for that purpose, and have since received the especial sanction and approbation of Her Majesty. They are directed to be given hereafter to such papers, and to such papers only, as have been presented to the Society, or inserted in its Transactions, within three years of the date of the award; and they are to be awarded to departments of science whose order of succession is defined by a cycle of three years, comprising in the first *Astronomy* and *Physiology*, in the second *Physics* and *Geology*, and in the third *Mathematics* and *Chemistry*. And it is further added and commanded, that no departure from this order of succession shall be allowed, unless it shall appear that no memoir of sufficient merit to be entitled to such an honour shall have been presented to the Society within the period afore-named; in which case, and in which case only, it shall be competent for the Council, with the approbation of Her Majesty, to award the Medal to one of those branches

of science which are comprehended in the cycle of the preceding year.

I trust, Gentlemen, that these laws for the distribution of the Royal Medals, if strictly adhered to, and judiciously administered, will be found to stimulate the exertions of men of science, by securing to their labours, when inserted in our Transactions, that certain and periodical revision which they are naturally so anxious to obtain; and by signalizing any remarkable investigation, or notable discovery, by the marked and prompt approbation of those persons in this country who are most likely to be able to judge of its value.

It was partly for the furtherance of the same great object, which was proposed in framing the statutes for the award of the Royal Medals, so as to secure to each branch of science in succession its due amount of notice and encouragement, that the Council have determined to establish permanent Committees of Science. They are composed of a selection of those Fellows of the Society who are known to have devoted their attention, in a more especial manner, to those departments of science to which they are severally assigned, and to whom all questions connected with such branches are proposed to be referred, including the selection of the memoirs to which the Royal Medals shall be given. The Council have thought proper, likewise, in the formation of these committees, to enlarge the number of the sciences, which form the Medallic cycle above referred to, from six to eight, by separating the science of Meteorology from that of Physics, and the science of Botany and the laws of Vegetable Organization and Life, from that of Zoology and Animal Physiology. I sincerely rejoice, Gentlemen, in the adoption of this arrangement, as I think it admirably calculated to give a more marked and specific distinction to those sciences which the Fellows of the Royal Society are bound more especially, by the obligations of the Charter, to cultivate, and as tending, likewise, to bring those persons who are engaged in common pursuits into more frequent intercourse with each other; and thus to afford them increased opportunities of appreciating their mutual labours, of devising new and important trains of investigation, as well as of securing public aid and general co-operation in the accomplishment of objects which are too costly or too vast for individuals to undertake or to attempt.

The future developement of many of the sciences is becoming daily more and more dependent upon co-operative labour. We are rapidly approaching great and comprehensive generalizations, which can only be completely established or disproved by very widely distributed and, in many cases, by absolutely simultaneous observations. Major Sabine has lately collected with great labour, and reduced and analysed with great ability, a vast mass of observations relating to the distribution of the earth's magnetism; and the result has pointed out not merely the proper fields of our future researches, but likewise their great extent and the enormous amount of labour still required for their cultivation. A society on the continent, headed by the justly celebrated Gauss, to whom the Copley Medal has been

this year adjudged for his magnetical researches, my cotemporary and fellow student at Göttingen, has instituted a system of simultaneous observations on the periodical and irregular movements of the magnetic needle at various stations in different parts of Europe, which suggest conclusions of the most surprising and interesting nature; these can only be fully worked out and confirmed by the adoption of a similar system of observations in places extremely remote from each other on the surface of the globe. The researches on the tides, which have been so laboriously and so successfully prosecuted by Professor Whewell and Mr. Lubbock, have led, and can lead to few general and certain conclusions without the aid of labours of this nature; and a memorable exemplification of their value, even when given in their rudest and least perfect form*, is presented in the discovery of the "Law of Storms," which Col. Reid has recently published, and which promises results so important to the interests of navigation and the cause of humanity. In the science of Meteorology, which still remains destitute even of approximations to general laws, it is to a well-organized system of simultaneous observations that we must look for the acquisition of such a knowledge of the range and character of atmospheric influences and changes, as may become the basis of a well-compacted and consistent theory, and rescue this science from the reproach, under which it has too long and too justly laboured, of presenting little more than a confused mass of almost entirely insulated results. Undertakings, however, of this extensive and laborious nature are far beyond the reach of individual enterprize, and can only be accomplished by national aid and co-operation.

We have lately witnessed an example where the Storthing, or National Assembly of Norway, a body composed partly of peasants, and representing one of the poorest countries in Europe, undertook the charge of a magnetical expedition to Siberia, on the recommendation and under the direction of their distinguished countryman, M. Hansteen, at the same time that they refused a grant of money to aid in building a palace for their sovereign; and I feel confident that the united wishes of men of science in this and other countries, whose influence on public opinion is becoming daily more and more manifest, particularly when expressed in favour of purely scientific objects which cannot be effected without the assistance and the resources of the nation, will not be without their effect on the Government of our own country, which has always taken the lead in the promotion of geographical as well as scientific investigations and discoveries, and which possesses, beyond any other nation, advantages for their prosecution and accomplishment, not merely from its superior wealth, but from the range and distribution of its commerce and its colonies in every region of the globe.

There is one other event to which I wish to advert previously to concluding this portion of my address to you, and which I conceive I may do with the strictest propriety, as it is closely connected with

* From the logs of ships.

the general interests of the Royal Society. I allude to the return of Sir John Herschel to this country, after an absence of several years, devoted, from a sense of filial duty, to the completion of that great task which he felt to have been transmitted to him as an inheritance from his venerable and illustrious father. I have so often had occasion to allude, from this Chair, to the merits of that distinguished person, and to express the respect which I felt for his great attainments, the pride with which I cherished his friendship, the deep interest which I took in his labours, and my admiration of the truly modest and philosophical spirit in which they were conducted, that I should be guilty of a very superfluous repetition of what I have before addressed to you, if I ventured to enlarge upon them now; but I should ill discharge my duty, whilst still entitled to address you as the official head of the scientific establishment of this country, if I omitted to avail myself of this or any other opportunity of expressing the gratification which I experienced in June last, when called upon to preside at that great convention of the most eminent men who adorn our country, who combined together with such singular unanimity and enthusiasm to pay their homage to science and knowledge, and those great interests with which their cultivation and progress are connected, by paying so signal a tribute of respect and honour to the most accomplished and the most devoted of our living philosophers. I feel assured, Gentlemen, that the proceedings of that memorable day will produce marked and durable effects upon the scientific prospects of our country, by proving that pre-eminent merit will meet with sympathy at least, if not with reward, and as offering sure and unequivocal indications both of the power and direction of public opinion amongst the most cultivated and enlightened classes of society; and it was chiefly as an expression of the deference paid by the government of this country to the opinions and wishes of the scientific world, that I rejoiced in being authorized and requested by the prime minister of the crown to offer to Sir John Herschel the rank of baronet, on the occasion of the coronation of Her Majesty, though well convinced that such an accession of social rank was not required to give dignity to one whose name is written in the imperishable records of the great system of the universe.

It would ill become me, while gratefully acknowledging my sense of your past kindnesses towards myself, to venture to refer to the name of my presumed successor in the Chair of this Society in any terms which might be interpreted as an undue anticipation of the result of this day's proceedings, or as appearing to interfere with the free use of the franchise which every Fellow possesses, and is expected and required to exercise; but I cannot be ignorant of the various accomplishments, the courteous and unassuming manners, the warmth of heart and active benevolence which distinguish the nobleman who has been nominated by the Council: and I rejoice most sincerely that the Society possesses amongst its members, as a candidate for your suffrages, one so well qualified to preside at your meetings, and to watch over your interests.

Amongst the deceased members, I find twenty-seven on the Home, and four on the Foreign list, including some very considerable names. I shall now proceed to notice such of their number as have been most distinguished for their scientific labours, for their public services, or for their encouragement and patronage of science and the arts.

Thomas Andrew Knight, of Downton Castle, Herefordshire, the President of the Horticultural Society of London, to the establishment and success of which he so greatly contributed, was born in the year 1758. He was educated at Ludlow school, and afterwards became a member of Balliol College, Oxford. From his earliest years he appears to have shown a predominant taste for experimental researches in gardening and vegetable physiology, which the immediate and uncontrolled possession of an ample fortune gave him every opportunity of indulging; proposing to himself in fact, as one of the great objects of his life, to effect improvements in the productions of the vegetable kingdom, by new modes of culture, by the impregnation of different varieties of the same species, and various other expedients, commensurate with those which had already been effected by agriculturists and others in the animal kingdom, by a careful selection of parents, by judicious crossing, and by the avoidance of too close an alliance of breeds. In the year 1795 he contributed to our Transactions his first, and perhaps his most important paper, on the transmission of the diseases of decay and old age of the parent-tree to all its descendants propagated by grafting or layers, being the result of experiments which had already been long continued and very extensively varied, and which developed views of the greatest importance and novelty in the economy of practical gardening, and likewise of very great interest in vegetable physiology. This paper was succeeded by more than twenty others, chiefly written between the years 1799 and 1812, containing the details of his most ingenious and original experimental researches on the ascent and descent of the sap in trees; on the origin and offices of the alburnum and bark; on the phenomena of germination; on the functions of leaves; on the influence of light, and upon many other subjects, constituting a series of facts and of deductions from them, which have exercised the most marked influence upon the progress of our knowledge of this most important department of the laws of vegetable organization and life.

Mr. Knight succeeded Sir Joseph Banks in the presidency of the Horticultural Society, and contributed no fewer than 114 papers to the different volumes of its Transactions: these contributions embrace almost every variety of subject connected with Horticulture; such as the production of new and improved varieties of fruits and vegetables; the adoption of new modes of grafting, planting, and training fruit-trees; the construction of forcing-frames and hot-houses; the economy of bees, and many other questions of practical gardening, presenting the most important results of his very numerous and well-devised experiments.

Mr. Knight was a person of great activity of body and mind,

and of singular perseverance and energy in the pursuit of his favourite science: he was a very lucid and agreeable writer, and it would be difficult to name any other cotemporary author in this or other countries who has made such important additions to our knowledge of horticulture and the economy of vegetation.

Sir Richard Colt Hoare, the owner of the beautiful domain of Stourhead in Wiltshire, was the author of many valuable historical and topographical works, and more especially of the history of his native county, presenting so numerous and such splendid funereal and other monuments of the primitive inhabitants of Great Britain, which he investigated with a perseverance and success unrivalled by any other antiquary. The early possession of an ample fortune and of all the luxuries of his noble residence, seem to have stimulated, rather than checked, the more ardent pursuit of those favourite studies, which occupied his almost exclusive attention for more than fifty years of his life: and he was at all times, both by his co-operation and patronage, ready to aid other labourers in the same field which he had himself cultivated with so much success and industry.

Sir Richard Hoare was a very voluminous original author, and on a great variety of subjects; he printed a catalogue of his unique collection of books relating to the history and topography of Italy, the whole of which he presented to the British Museum, to which he was, on other occasions, a liberal benefactor. He likewise published editions of many of our ancient chronicles; and it is only to be lamented that one who has contributed under so many forms to our knowledge of antiquity, and who presents so many claims to the grateful commemoration of the friends of literature and the arts, should have been influenced so much, and so frequently, by the very unhappy ambition, of which some well-known and distinguished literary bodies of our own time have set so unworthy an example, of giving an artificial value to their publications, by the extreme smallness of the number of copies which they allow to be printed or circulated; thus defeating the very objects of that great invention, whose triumphs were pretended to be the very groundwork of their association.

Mr. George Hibbert was one of the most distinguished of those princely merchants whose knowledge of literature, patronage of the arts, and extensive intercourse with the world have contributed so much, in a great commercial country like our own, to elevate the rank and character of the class to which they belong, and to give to the pursuits of wealth an enlarged and liberalizing spirit. Mr. Hibbert possessed, during the most active period of his life, an uncommon influence amongst the great commercial bodies of the metropolis, and more particularly amongst those connected with the West India trade, from his integrity and high character, his great knowledge of business, his excellent sense and judgement, and his clearness and readiness in public speaking. He was an excellent botanist, and the collection of plants which he had formed at his residence at Clapham, was remarkable not merely for its great extent, but likewise for the great number of extremely rare plants which it con-

tained. He was well known also as a very extensive and judicious collector of books, prints, drawings and paintings, and was endeared to a large circle of private friends, amongst the most cultivated classes of society in this country, by his refined yet simple manners, his happy temper, and his many social and domestic virtues.

Sir Abraham Hume, who had attained at the time of his death the venerable age of ninety years, was the father of the Royal Society; he was a man of cultivated taste and very extensive acquirements, and throughout his life a liberal patron and encourager of the fine arts.

Lord Farnborough was the son-in-law of Sir Abraham Hume, whom he greatly resembled in his tastes and accomplishments; for more than thirty years of his life he held various public situations in the successive administrations of this country, but quitted his official employments on his elevation to the peerage in 1826: from that period he devoted himself almost entirely to the improvement and decoration of his beautiful residence at Bromley Hill; to the proposal and promotion of plans for the architectural improvement of the metropolis; to the selection of pictures for the National Gallery, which he greatly enriched by his bequests; and to the various duties imposed upon him by his official connexion with the British Museum, and many other public institutions.

The Earl of Eldon, though possessing few relations with science or literature, presents too remarkable an example of the openings afforded by the institutions of this country to men of great and commanding talents for the attainment of the highest rank and wealth, to be passed over without notice in this obituary of our deceased Fellows. Lord Eldon was matriculated as a member of University College, Oxford, under the tuition of his brother, afterwards Lord Stowell, in 1766; and an academical prize which he gained in the following year, for an " Essay on the Advantages of Foreign Travel," gave the first evidence of his possession of those great powers of minute analysis and careful research, which made him afterwards so celebrated. His early marriage terminated somewhat prematurely his academical prospects, and forced him to adopt the profession of the law, after narrowly escaping other occupations of a much more humble character. He was compelled to struggle for several years of his life with poverty and discouragement, when a fortunate opportunity enabled him to give proof of his extraordinary attainments, and rapidly conducted him to the command of wealth and professional eminence. After filling with great distinction the offices of Solicitor and Attorney-General, he became Chief-Justice of the Common Pleas and a peer in 1799, and finally Lord Chancellor of England in 1801, a situation which he continued to hold, with a short interruption, for nearly a quarter of a century. Of his political character and conduct it becomes not me to speak; but his profound knowledge of the laws of England, his unrivalled acuteness and sagacity, and his perfect impartiality and love of justice, have received the concurrent acknowledgment and admiration of men of all parties.

The Rev. Thomas Catton, Senior Fellow of St. John's College,

Cambridge, was in early life a schoolfellow of Lord Nelson, of whose talents or character, however, he retained no very vivid impressions: he became a Member of the University in 1777, and when he took his degree in 1781 he was fourth Wrangler and first Smith's Prizeman, a discrepancy in the results of two similar examinations, which is said to have led to the adoption of some regulations preventing their recurrence in future. In the year 1800 he became one of the public tutors of his college, in conjunction with its present venerable and distinguished master, and secured, in a very uncommon degree, the respect and love of his pupils, by his skill and knowledge as a teacher, and by his kind and vigilant attention to their interests: he quitted the tuition in 1810, and for the remainder of his life he devoted himself, almost exclusively, to the cultivation of practical and theoretical astronomy, having succeeded to Mr. Ludlam in the management of the observatory which is placed over one of the interior gateways of the college. He possessed a most accurate knowledge of the theory and use of astronomical instruments, and was a most scrupulous and skilful observer; and he is known to have left behind a very large mass of observations, particularly of occultations, most carefully detailed and recorded. Mr. Catton was a man of very courteous manners and most amiable character, and possessed of a very extensive acquaintance both with literature and science. He died in the month of January last, in the eightieth year of his age, deeply regretted by the members of the college in which he had passed the greatest part of his life.

Mr. Henry Earle, one of the Senior Surgeons of St. Bartholomew's Hospital, was the son of one very eminent surgeon, Sir James Earle, and the grandson of another, Mr. Percival Pott. He was the author of many valuable articles in different medical journals, and likewise of two papers in our Transactions; one detailing the result of a very novel and difficult surgical operation, and the other on the mechanism of the spine, which were published in 1822 and 1823. Mr. Earle was considered to be one of the most skilful and scientific surgeons of his age, and was justly esteemed by his professional and other friends not merely for his great acquirements, but for his kindness of heart and upright and honourable character.

John Lloyd Williams, formerly British resident at Benares, was the author of three short papers in our Transactions in the year 1793; two of them upon the method of making ice at Benares, by means of extremely porous and shallow evaporating pans of unglazed earthenware, placed upon dry straw or sugar-cane; and the last furnishing additional descriptions of the great quadrants and gnomon in the observatory at Benares, which had been described in a paper in our Transactions in 1777 by Sir Robert Barker.

The Foreign Members whom the Society has lost during the last year, are Dr. Nathaniel Bowditch, of Boston, in America; Messieurs Dulong and Frederic Cuvier, of Paris; and Dr. Martin van Marum, of Haarlem.

Dr. Nathaniel Bowditch of Boston, in the State of Massachusetts in America, was born at Salem, in the same State, in 1773: he was

removed from school at the age of ten years to assist his father in his trade as a cooper, and was indebted for all his subsequent acquisitions, including the Latin and some modern languages and a profound knowledge of mathematics and astronomy, entirely to his own exertions unaided by any instruction whatever. He became afterwards a clerk to a ship-chandler, where his taste for astronomy first showed itself, and was sufficiently advanced to enable him to master the rules for the calculation of a lunar eclipse; and his subsequent occupation as supercargo in a merchant vessel sailing from Salem to the East Indies, led naturally to the further developement of his early tastes, by the active and assiduous study of those departments of that great and comprehensive science which are most immediately subservient to the purposes of navigation. It was owing to the reputation which he had thus acquired for his great knowledge of nautical astronomy, that he was employed by the booksellers to revise several successive editions of Hamilton Moore's Practical Navigator, which he afterwards replaced by an original work on the same subject, remarkable for the clearness and conciseness of its rules, for its numerous and comprehensive tables, the greatest part of which he had himself recalculated and reframed, and for its perfectly practical character as a manual of navigation: this work, which has been republished in this country, has been for many years almost exclusively used in the United States of America.

Dr. Bowditch having been early elected a Fellow of the American Academy of Arts and Sciences at Boston, commenced the publication of a series of communications in the Memoirs of that Society, which speedily established his reputation as one of the first astronomers and mathematicians of America, and attracted likewise the favourable notice of men of science in Europe.

During the last twenty years of his life, Dr. Bowditch was employed as the acting president of an Insurance Company at Salem, and latterly also as actuary of the Massachusetts Hospital Life Insurance Company at Boston: the income which he derived from these employments, and from the savings of former years, enabled him to abandon all other and more absorbing engagements, and to devote his leisure hours entirely to scientific pursuits. In 1815 he began his great work, the translation of the *Mécanique Céleste* of Laplace, the fourth and last volume of which was not quite completed at the time of his death. The American Academy over which he presided for many years, at a very early period of the progress of this very extensive and costly undertaking, very liberally offered to defray the expense of printing it; but he preferred to publish it from his own very limited means, and to dedicate it as a splendid and durable monument of his own labours and of the state of science in his country. He died in March last, in the sixty-fifth year of his age, after a life of singular usefulness and most laborious exertion, in the full enjoyment of every honour which his grateful countrymen in every part of America could pay to so distinguished a fellow-citizen.

Dr. Bowditch's translation of the great work of Laplace is a production of much labour and of no ordinary merit: every person who

is acquainted with the original must be aware of the great number of steps in the demonstrations which are left unsupplied, in many cases comprehending the entire processes which connect the enunciation of the propositions with the conclusions, and the constant reference which is made, both tacit and expressed, to results and principles, both analytical and mechanical, which are co-extensive with the entire range of known mathematical science: but in Dr. Bowditch's very elaborate commentary every deficient step is supplied, every suppressed demonstration is introduced, every reference explained and illustrated, and a work which the labours of an ordinary life could hardly master, is rendered accessible to every reader who is acquainted with the principles of the differential and integral calculus, and in possession of even an elementary knowledge of statical and dynamical principles.

When we consider the circumstances of Dr. Bowditch's early life, the obstacles which opposed his progress, the steady perseverance with which he overcame them, and the courage with which he ventured to expose the mysterious treasures of that sealed book, which had hitherto only been approached by those whose way had been cleared for them by a systematic and regular mathematical education, we shall be fully justified in pronouncing him to have been a most remarkable example of the pursuit of knowledge under difficulties, and well worthy of the enthusiastic respect and admiration of his countrymen, whose triumphs in the fields of practical science have fully equalled, if not surpassed, the noblest works of the ancient world.

Pierre Louis Dulong was born at Paris in 1785: he became an orphan at the age of four years; and though hardly possessing the most ordinary advantages of domestic instruction or public education, his premature talents and industry gained him admission at the age of 16 to the Polytechnic School, which has been so fertile in the production of great men, of which he became afterwards successively examiner, professor, and director. He first followed the profession of medicine, which he abandoned on being appointed Professor of Chemistry to the Faculty of Sciences. He became a member of the Institute in 1823, in the Section of the physical sciences. On the death of the elder Cuvier he was appointed Secretaire Perpetuel to the Institute, a situation from which he was afterwards compelled to retire by the pressure of those infirmities which terminated in his death in the fifty-fourth year of his age.

M. Dulong was almost equally distinguished for his profound knowledge of chemistry and of physical philosophy. His "Researches on the mutual decomposition of the soluble and insoluble Salts," form a most important contribution to our knowledge of chemical statics. He was the discoverer of the *hypophosphorous acid*, and also of the *chlorure of azote*, the most dangerous of chemical compounds, and his experiments upon it were prosecuted with a courage nearly allied to rashness, which twice exposed his life to serious danger; and his memoirs on the "Combinations of phosphorus with oxygen," on the "*hyponitric acid*," on the *oxalic acid*,

and other subjects, are sufficient to establish his character as a most ingenious and accurate experimenter, and as a chemical philosopher of the highest order.

But it is to his researches on the "Law of the conduction of heat," "On the specific heat of the gases," and "On the elastic force of steam at high temperatures," that his permanent fame as a philosopher will rest most securely: the first of these inquiries, which were undertaken in conjunction with the late M. Petit, was published in 1817; and presents an admirable example of the combination of well-directed and most laborious and patient experiment with most sagacious and careful induction: these researches terminated, as is well known, in the very important correction of the celebrated law of conduction, which Newton had announced in the Principia, and which Laplace, Poisson, and Fourier had taken as the basis of their beautiful mathematical theories of the propagation of heat. His experiments on the elastic force of steam at high temperatures, and which were full of danger and difficulty, were undertaken at the request of the Institute, and furnish results of the highest practical value; and though the conclusions deduced from his "Researches on the specific heat of gases" have not generally been admitted by chemical and physical philosophers, the memoir which contains them is replete with ingenious and novel speculations, which show a profound knowledge and familiar command of almost every department of physical science.

M. Frederic Cuvier, the younger brother of the illustrious Baron Cuvier, Professor of Animal Physiology to the Museum of Natural History at Paris, and Inspector-general of the University, was born at Montbelliard, in Alsace, in 1773: he had from an early period attached himself to those studies which his brother had cultivated with so much success, and his appointment as keeper of the menagerie at the Jardin des Plantes, furnished him with the most favourable opportunities of studying the habits of animals, and of prosecuting his researches on their physiology and structure. The Annales d'Histoire Naturelle, and the Mémoires du Muséum, contain a series of his memoirs on zoological subjects of great value and interest, and his work "*Sur les Dens des Mammifères considerées comme Caractères Zoologiques*," is full of novel and original views and observations, and has always been considered as one of the most valuable contributions to the science of Zoology which has been made in later times: the great work "*Sur l'Histoire des Mammifères*," of which seventy numbers have been published, was undertaken in conjunction with Geoffroy St. Hilaire, and is the most considerable and most extensive publication on Zoology which has appeared since the time of Buffon. He was likewise the author of many other works and memoirs on zoological subjects in various scientific journals and collections.

M. F. Cuvier, like his celebrated relative, combined a remarkable dignity and elevation of character, with the most affectionate temper and disposition. Like him, too, his acquisitions were not confined to his professional pursuits, but comprehended a very exten-

sive range of literature and science. In his capacity of inspector of the university, he devoted himself with extraordinary zeal to the improvement of the national education of France in all its departments, from the highest to the lowest. It was in the course of one of his tours of inspection that he was attacked at Strasburg with paralysis; the same disease which, under similar circumstances, had proved fatal to his brother, and likewise in the same year of his age.

Dr. Martin van Marum was secretary to the Batavian Society of Sciences at Haarlem, and superintended the publication of their Transactions for many years. He was also director of the Teylerian Museum at the same place, and the noble library of natural history and science which adorns that establishment was chiefly collected by his exertions: it was under his directions also that the great electrical machine belonging to the Teylerian Museum was constructed, and he published in 1795 and 1800 the results of a very extensive series of experiments on the various forms of electrical phenomena which were produced by it, and more particularly with reference to a comparison of its effects with those produced by a powerful voltaic pile, which were undertaken at the express request of Volta himself. Dr. van Marum was remarkable for his very various acquirements, and was the author of many memoirs in the Haarlem and other Transactions, on botanical, chemical, physical, and other subjects: he was a man of the most simple habits and of the most amiable character, and devoted himself most zealously during the greatest part of a very long life to the cultivation of science, and to the promotion of the interests of the establishment over which he presided.

Gentlemen, I have now arrived at the last and most painful part of my duty in addressing you, which is most gratefully and most respectfully to bid you farewell.

On the motion of Mr. Davies Gilbert, seconded by Mr. Hatchett, it was unanimously resolved that the cordial thanks of the Society be presented to His Royal Highness the Duke of Sussex for the numerous and valuable services which he has rendered the Society during the period of his filling the office of their President.

The following Report of the Council respecting the awards they have made of two Copley Medals, two Royal Medals, and one Rumford Medal, was read.

The Council have awarded a Copley Medal to Professor Gauss, for his researches and mathematical researches on Magnetism.

Professor Gauss's labours on the subject of magnetism, published at various periods, and continued with increasing activity up to the present time, have given to our knowledge of that subject very valuable and striking additions. In his dissertation entitled, "Intensitas vis magneticæ terristris at mensuram absolutam revocata," (Göttingen, 1833,) he showed how, by a skilful combination of experiment with mathematical calculation, several of the most difficult

problems belonging to the subject may be solved; namely, the determination of the magnetic axis of a needle; the exact determination of the moment of inertia of an oscillating needle; the deviation produced in the direction of the horizontal needle by the neighbourhood of a magnet; and the determination of the absolute intensity of the horizontal magnetic force of the earth. A combination of magnetic observers in different places had been set on foot by M. von Humboldt in 1828; a magnetic observatory was erected at Göttingen in 1833; and in consequence of these circumstances the curious discovery was made in 1834, that the minute momentary changes in the position of the horizontal needle are simultaneous and corresponding at distant places. This led M. Gauss to direct the attention of men of science more particularly to this subject; and the operations of the "Magnetic Union" of observers were carried on with great activity under his guidance. The "Results of the observations of the Magnetic Union" for 1836 and for 1837, published by MM. Gauss and W. Weber, contain an account of the consequences of these exertions. They also contain descriptions of instruments invented by M. Gauss for the purpose of these observations, namely, the *magnetometer*, and other magnetical apparatus of his construction, which has already been sent to the observatories of Bonn, Dublin, Freiberg, Greenwich, Kasan, Milan, Munich, Naples, Upsala, Krakow, Leipzig, and Marpurg. Also the *Bifilar Magnetometer*, which determines directly the variation of horizontal intensity. The "Results" further contain various mathematical calculations of great importance, on the subject of the above instruments, and of the observations made by them. And it appears by observations made in March, 1838, at Göttingen and three other places, with the Bifilar apparatus, that there is the same correspondence in the simultaneous changes of intensity at different places which had already been discovered in the declination. The ingenuity shown in the invention of instruments and processes, the mathematical skill employed in treating the observations, and the importance and interest of the results, are well deserving of being honourably marked by the Royal Society, and the adjudication of the Copley Medal to M. Gauss.

The Council have also awarded a Copley Medal to Dr. Faraday for his discovery of Specific Electrical Induction, published in the eleventh series of his Experimental Researches in Electricity.

From the peculiar view which he had taken of the phenomena of induction, Dr. Faraday was led to expect some particular relation of this process to different kinds of matter, through which it might be exerted. This relation he succeeded in establishing by the most decisive experiments.

The phenomena are shown in their simplest form by an instrument which he has named a Differential Inductometer. It consists of three insulated metallic plates, placed facing each other; the centre one being fixed, and the other two moveable upon slides, by which they may be approximated to or withdrawn from the centre.

Each end plate is connected with an insulated leaf of an electrometer. When a charge is communicated to the centre plate under ordinary circumstances, the induction is equal on both sides, and the gold leaves are not disturbed. But if after uninsulating them, and again insulating them, a thick plate of shell-lac or sulphur be interposed between two of the plates, unequal induction will take place on the two sides, and the gold leaves will attract one another. By these means Dr. Faraday ascertained that, taking the specific inductive capacity of air to be . . . . . . 1·

That of Glass is . . . . 1·76
Shell-lac . . . . 2·
Sulphur . . . . 2·24

The results obtained with spermaceti, oil of turpentine, and naphtha were higher than that of air, but their conducting powers interfered with the accuracy of the experiments.

By another form of apparatus he ascertained that all aëriform matter has the same power of sustaining induction; and that no variations in the density or elasticity of gases produced any variation in their electric tension until rarefaction is pushed so far as that discharge may take place across them.

Hot and cold air were compared together, and damp and dry air, but no difference was found in the results.

The great importance of the discovery and complete establishment of such a principle as that of specific inductive capacity, in all its relations both experimental and theoretic, is so palpable, that any comment must be superfluous; and the Council have felt they cannot better mark their sense of the value of this discovery than by awarding the Copley Medal to its author.

The Council have awarded the Royal Medal for Mathematics to H. F. Talbot, Esq., for his two memoirs entitled, "Researches in the Integral Calculus," published in the Philosophical Transactions for 1836 and 1837.

Nothing perhaps tends more directly to bring the correctness of refined theoretical investigations in physics to the test of numerical results, than improvements in and extensions of the processes of integration. Any advance therefore which is made in this difficult branch of analysis must be viewed not merely in the light of a difficulty overcome in the progress of abstract science, but likewise as having an important bearing on the advancement of physical inquiry.

The branch of analysis to which Mr. Talbot's researches belong is one which is connected with a long series of valuable investigations from the time of Fagnani and Euler to that of Legendre, Jacobi, and Abel: it relates to integrals under the same form which are separately nonscendental, but which furnish, under particular conditions of the variables, an algebraical result when two or more of them are connected together with the signs + or —. The celebrated theorem of Abel, which may be made to comprehend some of Mr. Talbot's results, is the most comprehensive and most important of all the general conclusions which have been arrived at in this de-

partment of analysis: but the process adopted by Mr. Talbot is more allied to that followed by Fagnani than by Abel, and is equally remarkable for its great simplicity and for the vast number of novel and interesting results which it furnishes, including not merely several of the most remarkable of those which are already known, but likewise many others which are apparently not deducible by other methods.

The Council have awarded the Royal Medal for Chemistry to Professor Thomas Graham for his paper entitled "Inquiries respecting the Constitution of Salts; of Oxalates, Nitrates, Phosphates, Sulphates, and Chlorides," which was read to the Society on the 24th of November 1836, and since published in the Philosophical Transactions. This paper they have considered as being the last of a series on a general subject of great importance: and as the sequel of Professor Graham's researches on the Arseniates, Phosphates, and modifications of Phosphoric Acid, read to the Society on the 19th of June 1833, and published in the Philosophical Transactions of the same year. He has therein shown that, by considering the water which enters into the composition of the different classes of salts, which the phosphoric acid forms with the several bases, and which has been considered as water of crystallization as standing in a *basic* relation to the acid, a very simple view might be taken of this very complicated subject. According to this theory, there are three sets of phosphates, in which the oxygen of the acid being 5, the oxygen in the base is respectively 3, 2, or 1; the remaining equivalents of oxygen, in the two first cases, being supplied by that portion which exists in the 2 or 3 equivalents, respectively, of the basic water, which water is wholly absent in the third case. These three classes of salts Professor Graham proposes to term, respectively, *monobasic*, *bibasic*, and *tribasic* salts. Professor Graham has extended these views of the basic formation of water in salts to the case of the sulphates, in a paper communicated to the Royal Society of Edinburgh, and published in the 13th volume of their Transactions, on "Water as a constituent of Salts." The principal object of this paper, however, was to show that water exists in a different state in certain salts, and does not exercise a true basic function, being capable of being replaced by a *salt*, and not by an *alkaline base*, and giving rise to a class of *double salts*. This inquiry was suggested by the tendency of phosphate of soda to unite with an additional dose of soda, and form a *subsalt*, which had been traced to the existence of basic water in the former. The result was, that in the well-known class of sulphates, consisting of sulphates of magnesia, zinc, iron, manganese, copper, nickel and cobalt, all of which crystallize with either five or seven equivalents of water, one equivalent proved to be much more strongly united to the salt than the other four or six. The latter, to which the name of *water of crystallization* should be restricted, may generally be expelled by a heat under the boiling point of water; while the remaining equivalent uniformly requires a heat above 400° of Fahrenheit for its expul-

sion, and seems to be, in a manner, essential to the salt. Thus in the double sulphate of zinc and potassa, the single equivalent of water, existing in the sulphate of zinc, is replaced by an equivalent of sulphate of potassa, while the six equivalents of water of crystallization remain; and all the other salts of this class combine with one another in a similar manner.

The super-sulphates must also be regarded as analogous to double salts; the bisulphate of potassa, for example, being a sulphate of water and potassa.

There is likewise a provision in the constitution of hydriated sulphuric acid for the production of a double salt analogous in its constitution to sulphate of zinc. Sulphuric acid, of the specific gravity 1·78, contains two equivalents of water, and is capable of crystallizing at a temperature of 40° of Fahrenheit, being, in fact, the only known crystallizable hydrate of sulphuric acid. The second equivalent of water, contained in the hydrated acid, is capable of being replaced by an equivalent of sulphate of potassa, which is itself a salt, and a bisulphate of potassa is the result of this substitution. But the first equivalent of water can be replaced only by an alkali, or true base. Professor Graham distinguishes water in these two states of combination as *basic* and *saline* water. Thus the hydrate of sulphuric acid, already mentioned, contains one equivalent of basic, and one equivalent of saline water. It is, in his nomenclature, a *sulphate of water with saline water*, as the hydrous sulphate of zinc is a *sulphate of zinc with saline water*. The bi-sulphate of potassa is also a *sulphate of water with sulphate of potassa*, and corresponds with the double salt of sulphate of zinc with sulphate of potassa.

The results which Professor Graham has thus obtained, and which he has communicated, partly to the Royal Society, and partly to the Royal Society of Edinburgh, suggested to him the probability that the law with respect to water in the constitution of the sulphates would extend to any hydrated acid, and the magnesian salt of that acid; and his researches on this extension of the subject constitute the substance of his last communication to the Royal Society. As he had already found that the sulphate of water is constituted like the sulphate of magnesia, so he now finds oxalate of water to resemble the oxalate of magnesia, and the nitrate of water to resemble the nitrate of magnesia. He is moreover of opinion, that this correspondence between water and the magnesian class of oxides extends beyond their character as bases, and that, in certain subsalts of this class, the metallic oxide replaces the water of crystallization of the neutral salt, and discharges a function which was thought peculiar to water.

The same kind of displacement, which takes place in the formation of a double sulphate by the substitution of a salt of the same class for an equivalent of water, appears to occur likewise in the constitution of double oxalates; and the application of this principle elucidates the constitution of that class of salts, as well as of the super-oxalates, and to explain the mode in which they are derived.

Lastly, the same law is traced in the constitution of the chlorides of the magnesian class of metals, which are found to have two equivalents of water strongly attached to them, and which may therefore be considered as constitutional. Many of them have two or four equivalents more, the proportion advancing by multiples of two equivalents.

Professor Graham has supported these views, not only by numerous arguments, but also by experimental investigations of the physical properties of different classes of salts, and a great number of chemical analyses; and he has thus largely added to our positive knowledge of this somewhat neglected branch of chemical science.

The Council, without pronouncing any judgement on the question whether Professor Graham's hypothesis concerning the different functions of water in the constitution of salts be a representation of the real mechanism of nature, are of opinion, that the discussion of his new and ingenious views will be highly conducive to the progress of science, particularly in the department of organic chemistry, in which they have been already followed out with success by some eminent foreign chemists, and have accordingly awarded to Professor Graham the Royal Medal for Chemistry of the present year, for his valuable researches in this department of science.

The Council have awarded the Rumford Medal to Professor Forbes, for his discoveries and investigations of the Polarization and Double Refraction of Heat, published in the recent volumes of the Transactions of the Royal Society of Edinburgh.

That solar heat, like the light which it accompanies, may be polarized, was shown by the early experiments of MM. Malus and Berard; but the announcement of M. Berard, that heat from other sources was also capable of polarization, not having been confirmed in subsequent repetitions of his experiments by other philosophers, it became of the highest importance to establish this analogy between light and heat from whatever source the latter might be derived.

The admirable instrument, the Thermo-multiplier, invented by MM. Nobili and Melloni, afforded facilities for the prosecution of inquiries of this nature, of which the inventors and others were not tardy in availing themselves. One of the most important results obtained by M. Melloni, and confirmed by Professor Forbes, the refrangibility of non-luminous heat by a prism of rock-salt, appeared to point to the polarization and double refraction of heat as almost necessary consequences. The experiments, however, of both these philosophers with tourmaline, undertaken nearly at the same time, appeared to negative the fact; but Professor Forbes becoming sensible of the source of error, in the conclusions he had at first drawn from his experiments, soon saw that his results clearly indicated the effect he was in search of. His subsequent experiments established the fact, that in the transmission of heat from an Argand lamp, from incandescent platinum, and even from non-luminous heated brass, through slices of tourmaline cut parallel to the axis of the crystal,

a portion of the heat is polarized, when the axes of the crystals are at right angles to each other; and these results were confirmed by M. Melloni.

But Professor Forbes did not allow the polarization of heat to rest solely upon the results obtained with tourmaline. By employing bundles of plates of mica, and adjusting them at proper angles, he not only obtained much more decisive results, particularly with heat from a non-luminous source, but such results as go to establish the singular fact, that the degree of the polarization of heat is dependent on the nature of its source. He has further shown the depolarization of heat by the interposition of a mica plate, and its circular polarization by means of two total internal reflections in an interposed rhomb, or two prisms of rock-salt.

The Council consider that they cannot better testify their estimation of the discoveries and experimental investigations of Professor Forbes, than by awarding to him a Medal, bequeathed by its distinguished founder, as a premium to the author of discoveries tending to improve the theories of heat and light.

The Statutes relating to the Election of Council and Officers having been read from the Chair, and the Rev. P. Jennings, D.D., and Joseph Smith, Esq., having, with the consent of the Society, been nominated Scrutators, to assist the Secretaries in examining the lists, the votes of the Fellows present were collected.

The Scrutators reported the result of the ballot to be as follows:

President.—The Marquis of Northampton.

Treasurer.—John William Lubbock, Esq., M.A., V.P.

Secretaries.—Peter Mark Roget, M.D.; Samuel Hunter Christie, Esq., M.A.

Foreign Secretary.—William Henry Smyth, Capt. R.N.

Other Members of the Council.—H.R.H. the Duke of Sussex, K.G., V.P.; Francis Baily, Esq., V.P.; John George Children, Esq., V.P.; John Frederic Daniell, Esq.; C. G. B. Daubeny, M.D.; Thomas Galloway, Esq., M.A.; Thomas Graham, Esq.; Sir John F. W. Herschel, Bart., M.A., V.P.; Francis Kiernan, Esq.; George Rennie, Esq.; John Forbes Royle, M.D., V.P.; Rev. Adam Sedgwick, M.A.; Robert Bentley Todd, M.D.; Charles Wheatstone, Esq.; Rev. William Whewell, M.A.; Rev. Robert Willis, M.A.

Whereupon the above-named gentlemen were declared duly elected; and thanks were voted to the Scrutators for their trouble on this occasion.

The following is the statement with respect to the Receipts and Payments of the Society during the preceding year, which was laid on the table by the Treasurer.

Statement of the Receipts and Payments of the Royal Society between Nov. 29, 1837, and Nov. 29, 1838.

RECEIPTS.

	£.	s.	d.	£.	s.	d.
Balance in the hands of the Treasurer at the last Audit ..				337	3	8
32 Weekly Contributions, at one shilling				83	4	0
136 Quarterly Contributions, at £1				516	0	0
32 Admission Fees				320	0	0
9 Compositions for Annual Payments at £60.				540	0	0
Rents:—						
One year's rent of estate at Mablethorpe: due at Michaelmas, (less the expenses of defending the Tythe suit, £55 13 3)	51	6	9			
One year's rent of lands at Acton: due at Michaelmas	60	0	0			
One year's fee-farm rent of lands in Sussex; land-tax deducted: due at Michaelmas ..	19	4	0			
One fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's will: due at Midsummer..................	3	0	0			
				133	10	9
Dividends on Stock:—						
One year's dividend on £14,000 Reduced 3 per cent. Annuities	420	0	0			
Dividend on £3452. 1. 1 Consols, the produce of the sale of the premises in Coleman-street..........................	103	11	2			
One year's dividend on £200 Consols	6	0	0			
Donation Fund.						
One year's dividend on £4150. 0. 0 Consols	124	10	0			
Rumford Fund.						
One year's dividend on £2161. 0. 10 Consols	64	16	6			
Fairchild Fund.						
One year's dividend on £100 New South Sea Annuities	3	0	0			
				721	17	8
Miscellaneous Receipts:—						
Sale of Philosophical Transactions and Abstracts of Papers............................				287	2	6
Total Receipts				£2938	18	7

PAYMENTS.

				£.	s.	d.
Fairchild Lecture.—The Rev. J. J. Ellis, for delivering the Fairchild Lecture for 1837				3	0	0
Ditto ditto for 1838				3	0	0
Bakerian Lecture.—James Ivory, Esq., for the Bakerian Lecture				4	0	0
Copley Medal.—Mr. Wyon for Eight Medals				42	16	0
British Museum Fund. Baillière for Books				24	10	0
——— Simpkin and Marshall for ditto				16	19	0
				94	5	0
Salaries :—	£.	s.	d.			
Dr. Roget, one year, as Secretary	105	0	0			
S. H. Christie, Esq., one year, as Secretary	105	0	0			
Ditto for Index to Phil. Trans.	5	5	0			
Capt. Smyth, one year, as Foreign Secretary	20	0	0			
Mr. Roberton, one year, as Assistant-Secretary	160	0	0			
Mr. W. E. Shuckard, one year, as Librarian	50	0	0			
Mr. Holtzer, one year, as Porter	30	0	0			
Ditto, for extra Porterage	10	0	0			
				485	5	0
Fire Insurance, on the Society's Property				22	11	6
Mrs. Coppard: Gratuity				10	0	0
Bills :—						
Taylor:						
Printing the Phil. Trans., 1837, part 2	177	2	9			
Ditto, 1838, part 1; Proceedings, Nos. 30—33; Circulars, Lists of Fellows, Ballot-lists, Statement of Payments, and Minutes of Council; &c. &c.	184	16	6			
Bowles and Gardiner:						
For Paper for the Phil. Trans., 1838, part 1	56	5	0			
Basire:						
For Engraving and Copper-plate Printing for Phil. Trans., 1838, part 1	27	18	6			
Walker:						
Engraving and Copper-plate Printing for the Phil. Trans., 1837, parts 1 and 2	119	0	0			
Gyde:						
Sewing and Boarding 800 Parts of Phil. Trans. 1837, part 2	27	8	0			
Ditto, 1838, part 1	27	6	8			
				619	17	5
Carried forward				£1231	18	11

	£.	s.	d.	£.	s.	d.
Brought forward..				1231	18	11
Ackermann:—For Emblazoned Leaf for the Queen's signature	5	5	0			
Chappell:—For Stationery	23	2	6			
Saunderson:—For Shipping Expenses	5	1	9			
Brecknell and Turner:—For Wax Lights, Candles, and Lamp Oil	36	6	6			
Bramah:—For Secretary's Box	3	14	6			
Cubitt:—For Repairing Windows, Carpets, &c.	12	1	3			
Gwillim:—For Brushes, Fire wood, &c.	4	10	2			
Exchequer Fee for paying dividend	0	13	0			
Wood:—For Coals	3	0	0			
Murray:—For taking Meteorological Observations	7	0	0			
Tuckett:—Binding Charters and Statutes for the Queen	2	16	0			
				103	10	8
Taxes and Parish Rates:						
Land and Assessed Taxes	35	3	9			
Poor Rate	15	11	8			
Church Rate	3	11	8			
Rector's Rate	1	16	3			
				56	3	4
Petty Charges:						
Window-cleaning, &c.	2	12	0			
Attending Clocks	1	11	6			
Postage and Carriage	17	0	0			
Expenses on Foreign Packets, &c.	8	16	3			
Stamps	3	3	6			
Charwoman's Wages	27	6	0			
Extra Charwoman's work	2	4	0			
Miscellaneous expenses	20	18	0			
				83	11	3
Total Payments....				£1475	4	2
Balance in the hands of the Bankers	1467	14	5			
Overpaid by Mr. Roberton	4	0	0			
Balance in the hands of the Treasurer				1463	14	5
				£2938	18	7

November 29*th*, 1838.

FRANCIS BAILY, *Treasurer.*

The Balances in hand, now belonging to the several trusts, are as under: viz:—

	£.	s.	d.
British Museum Fund	203	14	4
Donation Fund	233	16	4
Rumford Fund	259	6	6

The following table shows the progress and present state of the Society, with respect to the number of Fellows:

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2. 12. Annually.	Paying £4 Annually.	Total.
November, 1837	10	48	574	32	124	788
Since elected	1		7		23	31
Since re-instated ..			1		2	3
Since compounded			+ 2		− 2	
Since deceased, &c.		−4	−23	−3	− 1	−31
Defaulters					− 2	− 2
November, 1838	11	44	561	29	144	789

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1838. No. 36.

December 6, 1838.

JOHN W. LUBBOCK, Esq., V.P. and Treas., in the Chair.

Richard Charnock, Esq., was balloted for, but not elected into the Society.

The Rev. Philip Kalland, M.A., was balloted for, and duly elected into the Society.

A paper was in part read, entitled, "Experimental Researches in Electricity." *Fifteenth Series.*—"Note of the Character and Direction of the Electric Force of the Gymnotus." By Michael Faraday, Esq., D.C.L., F.R.S., &c.

December 13, 1838.

The MARQUESS of NORTHAMPTON, President, in the Chair.

The reading of a paper, entitled, "Experimental Researches in Electricity." *Fifteenth Series.*—"Note of the Character and Direction of the Electric Force of the Gymnotus." By Michael Faraday, Esq., D.C.L., F.R.S., &c., was resumed and concluded.

The author first briefly refers to what has been done by others in establishing the identity of the peculiar power in the Gymnotus and Torpedo with ordinary electricity, and then in reference to the intended conveyance to this country of Gymnoti from abroad, gives the instructions which he himself had received from Baron Humboldt for that purpose. A living Gymnotus, now in the possession of the Proprietors of the Gallery of Science in Adelaide Street, was placed for a time at the disposal of the author for the purpose of research, upon which he proceeded, with suitable apparatus, to compare its power with ordinary and voltaic electricity, and to obtain the direction of the force. Without removing it from the water he was able to obtain not only the results procured by others, but the other electrical phenomena required so as to leave no gap or deficiency in the evidence of identity. The shock, in very varied circumstances of position, was procured: the galvanometer affected; magnets were made; a wire was heated; polar chemical decomposition was effected, and the spark obtained. By comparative experiments made with the

animal and a powerful Leyden battery, it was concluded that the quantity of force in each shock of the former was very great. It was also ascertained by all the tests capable of bearing on the point, that the current of electricity was, in every case, from the anterior parts of the animal through the water or surrounding conductors to the posterior parts. The author then proceeds to express his hope that by means of these organs and the similar parts of the Torpedo, a relation as to *action* and *re-action* of the electric and nervous powers may be established experimentally; and he briefly describes the form of experiment which seems likely to yield positive results of this kind.

December 20, 1838.

JOHN GEORGE CHILDREN, Esq., V.P., in the Chair.

Prof. Louis Agassiz, and Prof. Carl. Fred. Philip von Martius, were severally elected Foreign Members of the Society.

A paper was read, entitled, "On the Curvature of Surfaces." By John R. Young, Esq. Communicated by John W. Lubbock, Esq., M.A., V.P. and Treas. R.S.

The principal object of this paper is, to remove the obscurity in which that part of the theory of the curvature of surfaces which relates to umbilical points has been left by Monge and Dupin, to whom, however, subsequently to the labours of Euler, we are chiefly indebted for a comprehensive and systematic theory of the curvature of surfaces. In it the author shows, that the lines of curvature at an umbilic are not, as at other points on a surface, two in number, or, as had been stated by Dupin, limited; but that they proceed in every possible direction from the umbilic.

The obscurity complained of is attributed to the inaccurate conceptions entertained by Monge and Dupin, of the import of the symbol $\frac{0}{0}$ in the analytical discussion of this question, the equation which determines the directions of the lines of curvature taking the form

$$0\left(\frac{dy}{dx}\right)^2 + 0\left(\frac{dy}{dx}\right) + 0 = 0$$

at an umbilic. After stating that Dupin has been guided by the determination of the differential calculus, the author remarks, that in no case is the differential calculus competent to decide whether $\frac{0}{0}$, the form which a general analytical result takes in certain particular hypotheses, as to the arbitrary quantities entering that result, has or has not innumerable values. He then states the principle, that those values of the arbitrary quantities (and none else) which render the equations of condition indeterminate must also render the final re-

sult, to which they lead, equally indeterminate; and that, therefore, when such result assumes the form $\frac{0}{0}$, its true character is to be tested by the equations that have led to it, after these have been modified by the hypothesis from which that form has arisen.

In a "Mémoire sur la Courbure des Surfaces," (Journal de l'École Polytechnique, Tom. XIII.), Poisson has arrived at the conclusion, that the number of lines of curvature passing through an umbilical point is infinite, and that those selected by Dupin differ from the others only by satisfying an additional differential equation; those others equally satisfying the conditions of a line of curvature. These are precisely the conclusions arrived at by the author. As, however, he considers that the mode of investigation pursued by Poisson is peculiar and ill adapted to the objects apparently in view, namely, to reconcile the results of Monge and Dupin and to remove their obscurities, he was induced to investigate some of the more important properties of curve surfaces, by a method somewhat different from that usually employed.

Adopting
$$\mathrm{Z} = \mathrm{F}(\mathrm{X}, \mathrm{Y})$$
as the general equation of any surface; by attributing to X, Y, Z, increments x, y, z, and assuming that the axis Z coincides with the normal to the surface, or that the plane $x\,y$ is parallel to the tangent plane, an equation equivalent to, and nearly identical with, Dupin's equation of his indicatrix, is readily deduced. From this are immediately derived some properties of the radii of curvature, first shown by Dupin; and likewise the theorem of Meusnier. The author then enters upon the subject of the lines of curvature.

From the equations
$$\mathrm{A} = 0, \qquad \mathrm{B} = 0,$$
of the normal to the surface at a point on it, the equations of the normal at a point near to the former are determined. That these normals may intersect, which is the condition giving the directions of the lines of curvature, the two sets of equations must simultaneously exist; and hence are deduced the differential equations of condition for the lines of curvature,

$$\frac{d\mathrm{A}}{dx} + \frac{d\mathrm{A}}{dy} \cdot \frac{dy}{dx} = 0, \qquad \frac{d\mathrm{B}}{dx} + \frac{d\mathrm{B}}{dy} \cdot \frac{dy}{dx} = 0.$$

By this method, which fundamentally is not very different from that of Monge, substituting the usual expressions for A and B, the equation that determines the directions of the lines of curvature is deduced, in the form in which it had been previously given by Monge and Dupin.

This final equation becoming at an umbilic of the form,

$$0\left(\frac{dy}{dx}\right)^2 + 0\left(\frac{dy}{dx}\right) + 0 = 0,$$

in which $\frac{dy}{dx}$ *may* be indeterminate, the author inquires how this in-

determinate form will affect the equations of condition. As by this supposition, these are reduced to equations from which would result the conditions that would render all the coefficients of the determining equation 0, it is inferred that $\frac{dy}{dx}$ *must* be indeterminate, and that therefore, at an umbilic there issue lines of curvature in all directions.

Of these lines of curvature, it is possible that some may be distinguished from others, by proceeding from the point in more intimate contact with the osculating sphere, and it is therefore necessary to determine the analytical character of such particular lines of curvature. With this view, the author resumes the equation of the normal in the immediate vicinity of the umbilic. He then points out, that a straight line, whose equations contain the second differential coefficients, thus involving a new condition, will coincide more nearly with this normal, than can any straight line not having that condition. That the lines may intersect in the centre of the osculating sphere, their equations must simultaneously exist; and thus, that which most nearly coincides with the normal in the immediate vicinity of the umbilic has the new conditions,

$$\frac{d^2 A}{d x^2} + 2 \frac{d^2 A}{d x \, d y} \cdot \frac{d y}{d x} + \frac{d^2 A}{d y^2} \cdot \frac{d y^2}{d x^2} = 0,$$

$$\frac{d^2 B}{d x^2} + 2 \frac{d^2 B}{d x \, d y} \cdot \frac{d y}{d x} + \frac{d^2 B}{d y^2} \cdot \frac{d y^2}{d x^2} = 0,$$

in addition to the former ones.

From this it appears, that when the direction of a line of curvature issuing from an umbilic is such as to fulfil, besides the ordinary conditions, the foregoing new conditions, that line of curvature will lie more closely to the osculating sphere than any other not satisfying these additional equations. These new conditions arise from differentiating the preceding ones with respect to x and y, considered as dependent, regarding $\frac{dy}{dx}$ as constant; and as these are equivalent to a single condition (Monge's and Dupin's equation) it will be sufficient to differentiate this, under the above restrictions, in order to obtain a single condition equivalent to the new ones. As this single condition will appear under the form of an equation of the third degree in $\frac{dy}{dx}$, there will, in general, be at least one line of curvature, proceeding from the umbilic, of more than ordinary closeness to the osculating sphere; and there may be three. If, indeed, this equation of the third degree should, like that of the second from which it is deduced, be identical for the coordinates of the umbilic, it is obvious from the investigation, that we must then proceed to another differentiation; and so on, till we arrive at a determinate equation, the real roots of which will make known the number and directions of the lines of closest contact.

When, however, the author remarks in conclusion, all the lines of curvature issuing from the umbilic are equally close to the osculating sphere, then these successive differentiations will either at length exhaust the coefficients, and thus no determinate equation will arise; or else they will conduct to an equation whose roots are all imaginary: and one or other of these circumstances must always take place at the vertex of a surface of revolution.

The Society adjourned over the Christmas Recess to meet again on the 10th January next.

January 10, 1839.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treas., in the Chair.

William James Frodsham, and John Hilton, Esquires, were severally elected Fellows of the Society.

A paper was read, entitled, "On the Laws of Mortality." By Charles Jellicoe, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author, considering that the variations and discrepancies in the annual decrements of life which are exhibited in the tables of mortality hitherto published would probably disappear, and that these decrements would follow a perfectly regular and uniform law, if the observations on which they are founded were sufficiently numerous, endeavours to arrive at an approximation to such a law, by proper interpolations in the series of the numbers of persons living at every tenth year of human life. The method he proposes, for the attainment of this object, is that of taking, by proper formulæ, the successive orders of differences, until the last order either disappears, or may be assumed equal to zero. With the aid of such differences, of which, by applying these formulæ, he gives the calculation, he constructs tables of the annual decrements founded principally on the results of the experience of the Equitable Assurance Society.

January 17, 1839.

JOHN FORBES ROYLE, M.D., V.P., in the Chair.

Beriah Botfield, and Peter Hardy, Esquires, were severally elected Fellows of the Society.

A paper was read, entitled, "On the state of the Interior of the Earth." By W. Hopkins, Esq. A.M., F.R.S., Second Memoir. "On the Phenomena of Precession and Nutation, assuming the Fluidity of the Interior of the Earth."

In this memoir the author investigates the amount of the luni-solar precession and nutation, assuming the earth to consist of a solid spheroidal shell filled with fluid. For the purpose of presenting the problem under its most simple form, he first supposes the solid shell to be bounded by a determinate inner spheroidal surface, of which the ellipticity is equal to that of the outer surface; the change from the solidity of the shell to the fluidity of the included mass being, not gradual, but abrupt. He also here supposes both the shell and the fluid to be homogeneous, and of equal density. The author then gives the statement of the problem which he proposes to investigate; the investigation itself, which occupies the remainder of the paper, being wholly analytical, and insusceptible of abridgement. The following, however, are the results to which he is conducted by this laborious process: namely, that, on the hypothesis above stated, 1. The Precession will be the same, whatever be the thickness of the shell, as if the whole earth were homogeneous and solid. 2. The Lunar Nutation will be the same as for the homogeneous spheroid to such a degree of approximation that the difference would be inappreciable to observation. 3. The Solar Nutation will be sensibly the same as for the homogeneous spheroid, unless the thickness of the shell be very nearly of a certain value, namely, something less than one quarter of the earth's radius; in which case this nutation might become much greater than for the solid spheroid. 4. In addition to the above motions of precession and nutation, the pole of the earth would have a small circular motion, depending entirely on the internal fluidity. The radius of the circle thus described would be greatest when the thickness of the shell was the least: but the inequality thus produced would not, for the smallest thickness of the shell, exceed a quantity of the same order as the polar nutation, and for any but the most inconsiderable thickness of the shell would be entirely inappreciable to observation.

In his next communication, the author purposes considering the case in which both the solid shell and the inclosed fluid mass are of variable density.

"Apperçu sur une manière nouvelle d'envisager la théorie cristallographique dans le but d'établir les rapports de celle-ci avec la forme sphérique, ou elliptique, des molécules, ainsi qu'avec l'effet des milieux sur la forme cristalline." Par M. L. A. Necker. Communicated by P. M. Roget, M.D., Sec. R.S.

In this communication, after adverting to Haüy's theory of crystallization, in which the molecules are considered to be polyhedrons, to the views subsequently taken by Wollaston and Davy, and particularly to Brewster's conclusions, that there ought to be different forms of molecules, some spherical, some elliptical with two equal axes, and a third unequal to these, and others elliptical with three unequal axes; M. Necker states, that Mr. Dana is the only mineralogist who has attempted to introduce into crystallography the consideration of molecules with curved surfaces. Although, adopting the forms proposed by Brewster, and adding to them those

of oblique solids, by introducing the idea of polarity in the axes of crystallization, Mr. Dana has successfully applied this molecular theory to crystallography, yet he goes no farther; and the most important and difficult steps in this branch of physical science still remain to be made, and many phenomena in crystallization, with the cause of which we are at present wholly unacquainted, still require to be explained by the theory. The author particularly refers to the important facts discovered by MM. Leblanc and Beudant, of the influence that solutions or mediums in which bodies crystallize have on the secondary forms which these bodies take; and states, that the present views of crystallography afford not even a glimpse of the least relation between such forms and the properties of the mediums. Why, he asks, does pure water appear, in general, to tend to simplify the forms, precisely as do certain mixtures, those of chlorite in axinite, quartz, felspar, &c., and why, on the contrary, do other mediums, acid or earthy, complicate them?

Impressed with the importance which must attach to the solution of such questions, M. Necker offers some ideas which long meditation on this important subject has suggested to him.

Adopting the ellipsoid as the form of the molecule, he remarks, that the more complicated the form of the crystal, the more the number of its faces increases, and the more, at the same time, does it approach to the ellipsoidal form of the molecule; and, on the contrary, the simpler the form becomes, the more does it recede from that with a curved surface. All crystalline forms may be considered as making a part of one or more series, which, in each system of crystallization, have for extreme terms, on the one side, the most simple solid of the system, or that which has the least number possible of faces, and on the other, the solid having the greatest number, namely a sphere or an ellipsoid. Although it is more convenient in the calculation of forms to start from the most simple polyhedral forms in order to arrive at the more complex, nothing proves that such has been the route which nature has followed. As long as we considered the integral molecules as polyhedral, it appeared natural to view them as grouping in polyhedrons; but when once we cease to admit polyhedral molecules, it then becomes most natural to suppose, that ellipsoidal molecules should have a tendency, more or less decided, to group in solids of the same form as themselves, when no extraneous circumstances interpose an obstacle to this tendency.

In order to give an idea of the kind of effect which would be produced on the form of the solid by these obstacles, such as the nature of the medium in which crystallization takes place, a hurried or tumultuous crystallization, &c., the author conceives that each molecule, as well as each solid formed by their union, has different axes of attraction, endued with different degrees of energy, and symmetrically disposed in groups, the weaker and the most numerous round the stronger, which are, at the same time, the smallest in number; all, in short, symmetrically arranged around the principal axes of crystallization, which are the most energetic of all. Thus we shall conceive that sort of polarity by which crystallization is distin-

guished from molecular attraction. The effect of obstacles, such as the attraction exerted by mediums, by interposed bodies, by the molecular attraction of the molecules themselves, when they arrive both in too great numbers and too rapidly towards the same point, will be the annihilation of the weaker axes; whence will follow the formation of a tangent plane to the spherical or elliptical surface. If the action of the obstacle goes on increasing, axes of attraction, which, by their intensity, had resisted the first obstacles, are destroyed by the new ones; and new tangential planes are produced, in which those that had been first formed finish by being confounded: thus it will happen that, by the increase of obstacles, the surface of the solid from being curved has become polyhedral, and finishes by presenting only an assemblage of a small number of plane faces, separated by edges, and placed tangentially at the extremity of the axes whose forces have longest resisted the action of the obstacles. But since the most energetic axes are necessarily the least numerous, the greater the energy they possess, the number of faces which bound the solid will continually decrease according as the obstacles increase; until, at length, the solid, reduced to its most simple form, no longer presents any but that constituted by the principal axes of crystallization, terminating at the summits of the solid angles of the simple polyhedron, which axes alone have been capable of withstanding the action of all the obstacles opposed to the tendency of the molecules to unite in the form of an ellipsoid.

On this hypothesis, the author explains how common salt, alum, sulphate of iron, &c., crystallize in pure water in the most simple forms, the reciprocal attraction of their molecules being controlled and diminished by the affinity exerted on them by the molecules of the water; whilst if some of these molecules of water are neutralized by mixture with another soluble principle, they cease to act as an obstacle to the crystallization of the body, which then takes forms more complicated and approaching nearer to that of the normal solid with a curved surface.

M. Necker considers that the new views he has sketched require, for their complete developement, many ulterior details, as well as many new experiments and new facts; but that the tendency which the crystals of all systems present, to progress towards the curved surface form appropriate to each system, by the complication of their forces, is a fundamental fact of the first importance; and that an advance has been made by showing the bearing of the important experiments of MM. Leblanc and Beudant, and by having brought the theory of crystallography nearer to those views which the progress of chemistry and of physics have led us to adopt, relative to the form of the elementary molecules of bodies.

January 24, 1839.

FRANCIS BAILY, Esq., V.P., in the Chair.

Charles Darwin, Esq., was elected a Fellow of the Society.

A paper was read, entitled, "Experiments made on a piece of Peña silver, saved from the Lady Charlotte, wrecked on the coast of Ireland in December 1838, as to its capability of holding water." By W. D. Haggard, Esq. Communicated by Sir Henry Ellis, K.H., F.R.S.

Plata Peña, so called, is silver collected by quicksilver after the ore is pounded; it is then placed in a mould, and by great force the quicksilver is squeezed out, when it forms a mass, resembling dry mortar, of great porosity.

	Troy Weight.			Decrease in weight.		
	lbs.	oz.	dwts.	lbs.	oz.	dwts.
Original weight when taken from the box	38	10	0			
One day placed before the fire	37	0	15	1	9	5
Third day	35	5	0	1	7	0
Fifth day	34	5	5	0	11	15
Eighth day	34	0	2	0	5	3
Weight of water				4	9	3

				Increase in weight.		
				lbs.	oz.	dwts.
Weight of the piece supposed to be quite dry	34	0	2			
First day from the fire	34	0	3	0	0	1
Third day	34	2	5	0	2	2
Fifth day	34	4	2	0	1	17
Eighth day	34	4	9	0	0	7
Gained in water from the air				0	4	7
Weight after water had been forced into it	39	1	19	4	9	10
Total weight of water contained in the piece				5	1	17

A paper was also read, entitled, "On the Application of the Conversion of Chlorates and Nitrates into Chlorides, and of Chlorides into Nitrates, to the determination of several equivalent numbers." By Frederick Penny, Esq. Communicated by H. Hennell, Esq. F.R.S.

The researches which form the subject of this paper were suggested by an inquiry into the most effectual method of ascertaining the quantity of nitrate of potassa existing in crude saltpetre. The author found that by the action of hydrochloric acid the nitrate of potassa was converted into the chloride of potassium; and conversely, that the chloride of potassium might, by the proper regulation of the temperature, be reconverted into the nitrate of potassa by the action of nitric acid. These mutual conversions afforded excellent means of determining, with great exactness, the relative equivalent numbers, in the theory of definite proportions, belonging to these salts, and to their respective constituent elements. The author, accordingly, pursued the investigation of these numbers by several successive steps, of which the details occupy the greater part of the present paper. He first determines the equivalent of chloride of potassium by decomposing chlorate of potassa into oxygen and chlo-

ride of potassium; the proportion between which gives the ratio which the respective equivalent numbers of each bear to one another, and also to that of chlorate of potassa. The equivalent of nitrate of potassa is next obtained by converting the chlorate and the chloride of potassium into that salt; and from these data the equivalents of chlorine and of nitrogen are deduced. A similar train of inquiry is next instituted with the corresponding salts having sodium for their base: chlorate of soda being decomposed into the chloride, and into the nitrate; nitrate of soda into chloride; and chloride of sodium into nitrate of soda. The results of these different series of experiments coincide so closely with one another as mutually to confirm their general accuracy in the most satisfactory manner. For the purpose of determining the equivalent numbers of the elementary bodies themselves, (namely, chlorine, nitrogen, potassium, and sodium,) the author employed the intermedium of silver, the several saline combinations of which with chlorine and with nitric acid were found to afford peculiar advantages for the accurate determination of the relative weights of the constituents of these salts, when subjected to various combinations and decompositions. The conclusions to which the author arrives with regard to the equivalent numbers for the six elementary bodies in question, tend to corroborate the views of the late Dr. Turner, and to overturn the favourite hypothesis that all equivalent numbers are simple multiples of that for hydrogen. He finds these numbers to be as follow:

Oxygen..............	8·
Chlorine	35·45
Nitrogen	14·02
Potassium............	39·08
Sodium..............	23·05
Silver................	107·97

The author intends to pursue these inquiries, by applying similar methods to the investigation of other classes of salts.

January 31, 1839.

JOHN W. LUBBOCK, Esq., Vice-President and Treas., in the Chair.

John Wesley Williams, and James Yates, Esqrs., were severally elected Fellows of the Society.

A paper was read, entitled, "Some account of the Art of Photogenic Drawing, or the Process by which Natural Objects may be made to delineate themselves without the aid of the Artist's Pencil." By H. F. Talbot, Esq., F.R.S.

In this communication the author states, that during the last four or five years he has invented and brought to a considerable degree

of perfection, a process for copying the forms of natural objects by means of solar light, which is received upon paper previously prepared in a particular manner. He observes, that a prior attempt of this kind is recorded in the Journal of the Royal Institution for 1802; by which it appears that the idea was originally suggested by Mr. Wedgwood, and afterwards experimented on by Sir Humphry Davy. These philosophers found, that their principle, though theoretically true, yet failed in practice, on account of certain difficulties; the two principal of which were: *first*, that the paper could not be rendered sufficiently sensible to receive any impression whatever from the feeble light of a camera obscura; and *secondly*, that the pictures which were formed by the solar rays could not be preserved, owing to their still continuing to be acted upon by the light.

The author states that his experiments were begun without his being aware of this prior attempt; and that in the course of them he discovered methods of overcoming the two difficulties above related. With respect to the latter, he says, that he has found it possible by a subsequent process, so to fix the images or shadows formed by the solar rays, that they become insensible to light, and consequently admit of being preserved during any length of time: as an example of which, he mentions, that he has exposed some of his pictures to the sunshine for the space of an hour, without injury.

With respect to the other point, he states that he has succeeded in discovering a method of preparing the paper which renders it much more sensitive to light than any which had been used previously; and by means of which he finds, that there is no difficulty in fixing the pictures given by the camera obscura and by the solar microscope.

He states that in the summer of 1835 he made a great number of portraits of a house in the country of ancient architecture, several of which were this evening exhibited to the Society.

After some speculations on the possibility of discovering a yet more sensitive paper, the author mentions, that the kind employed by him may be rendered so much so, as to become visibly affected by the full light of the sun, in the space of half a second.

The rest of this paper contains an account of various other ways in which this method may be employed in practice, according to the kind of object which it is required to copy: also, a brief mention of the great variety of effects resulting from comparatively small differences in the mode of preparation of the paper: and, of certain anomalies which occur in the process, the cause of which has not hitherto been rendered distinctly manifest.

In conclusion, the author designates this as "a new process. which he offers to the lovers of science and nature."

February 7, 1839.

The MARQUESS of NORTHAMPTON, President, in the Chair.

James Heywood, Esq., and the Rev. Henry Moseley, M.A., were severally elected Fellows of the Society.

A paper was read, entitled, "Notice of a Shock of an Earthquake felt in the Island of St. Mary's, one of the Scilly Islands, on the 21st of January, 1839," in a letter addressed to the Secretary. By the Rev. George Wordley.

The tremulous motion of the ground is described as being very slight, and felt chiefly in the south parts of the island. It was accompanied by a peculiarly harsh and grating sound, which was only of momentary duration, and no particular agitation of the sea was observed.

A paper was in part read, entitled, "Observations on the Parallel Roads of Glen Roy, and of other parts of Lochabar, with an attempt to prove that they are of Marine Origin." By Charles Darwin, Esq., M.A., F.R.S., Sec. Geol. Soc.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1839. No. 37.

February 14, 1839.

JOHN W. LUBBOCK, Esq., V.P. and Treas., in the Chair.

The Right Honourable Lord Carrington, was balloted for, and duly elected into the Society.

A paper was read, entitled, "Researches on the Chemical Equivalents of certain Bodies." By Richard Phillips, Esq., F.R.S.

The author examines, by a new series of experiments, the truth of the theory of Dr. Prout and Dr. Thomson, namely, that "all atomic weights are simple multiples of that of hydrogen," a theory which the late Dr. Turner had maintained is at variance with the most exact analytic researches, and consequently untenable. Although the experiments of Dr. Turner, and the inferences which he drew from them, agree very nearly with those of Berzelius, it still appeared to the author desirable to investigate this subject; and it occurred to him that the inquiry might be conducted in a mode not liable to some of the objections which might be urged against the processes usually employed.

Dr. Turner having adopted a whole number, namely 108, as the equivalent of silver, this substance was selected by the author as the basis of his inquiry into the equivalent numbers of chlorine, and some other elementary gases. It appeared to him that the chance of error arising from the fusing of the chloride of silver might be entirely removed, and other advantages gained, by experimenting on silver on a large scale, with such proportions of the substances employed as were deemed to be equivalents; and instead of calculating from the whole product of the fused chloride, to do it merely from the weight of such small portion only, as might arise from the difference between theoretical views and experimental results.

The author concludes, from the train of reasoning he applies to the series of experiments so undertaken, that no material, and even scarcely any appreciable error can arise from considering the equivalent numbers of hydrogen, oxygen, azote, and chlorine, as being 1, 8, 14, and 36 respectively.

A paper was also read, entitled, "Some Account of the Hurricane of the 7th of January, 1839, as it was experienced in the neighbourhood of Dumfries," in a letter addressed to P. M. Roget, M.D. Secretary to the Royal Society. By P. Garden, Esq. Communicated by Dr. Roget.

After describing the position of his house, and the nature of the instruments employed for observation, the writer gives his observations of the barometer and thermometer on the 6th and 7th of January last, and proceeds to state, that on the 6th, at about ten minutes past ten o'clock p.m. violent squalls commenced, at first with intermissions of perfect calms, but gradually becoming more frequent, and being accompanied by the sound of strong and increasing whirlwinds. By eleven o'clock the wind was observed to proceed from the East, and its velocity was estimated at forty miles an hour. Its violence then increased, and threatened to blow down the chimneys. At midnight it abated, at the same time shifting to the south or west. At two o'clock in the morning nearly two tons of lead were torn away by the wind from the west end platform on the house-top, and thrown down behind the house in a westerly direction. Some of the lower windows having been left a little open, the wind thus admitted into the house forced up and blew off the very heavy hatch-door of the roof, which was covered with lead. The whole house rocked terribly, and even the stone floor of the half-sunk kitchen story heaved as if shaken by an earthquake: the slates from the roof were blown in every direction, some being carried to a prodigious distance. During the greater part of the night the rain fell in tremendous torrents. In the interval from two to half-past three in the morning, the barometer sunk very nearly an inch and a half, and reached its greatest depression. But the tempest continued till about four o'clock, when it began gradually to subside. Extensive devastation occurred among the trees; some that were blown down raising two or three tons of clay soil with the roots. Several trees thus thrown down fell with their tops to the W.N.W.

The writer concludes from these and other observations, that the first and squally part of the storm began from the E.S.E., and blew from S. by W. at about midnight; and that most injury was done to the slating and roof when the wind was not far from the south. It then gradually veered to the west, till noon, and reached the N.W. point by eight o'clock in the evening of the same day.

February 21, 1839.

JOHN GEORGE CHILDREN, Esq., V.P., in the Chair.

Captain Arthur Conolly and Lieut.-Colonel William Reid, C.B., R.E., were balloted for, and duly elected into the Society.

A paper was read, entitled, "An Account of the Processes employed in Photogenic Drawing," in a letter to S. Hunter Christie, Esq., Sec. R.S. By H. Fox Talbot, Esq., F.R.S.

The subject, Mr. Talbot observes, naturally divides itself into two heads,—the preparation of the paper, and the means of fixing the design.

In order to make what may be called ordinary Photogenic paper, the author selects, in the first place, paper of a good firm quality and smooth surface; and thinks that none answers better than su-

perfine writing paper. He dips it into a *weak* solution of common salt, and wipes it dry, by which the salt is uniformly distributed throughout its substance. He then spreads a solution of nitrate of silver on one surface only, and dries it at the fire. The solution should not be saturated, but six or eight times diluted with water. When dry, the paper is fit for use. He has found by experiment that there is a certain proportion between the quantity of salt and that of the solution of silver which answers best, and gives the maximum effect. If the strength of the salt is augmented beyond this point, the effect diminishes, and in certain cases becomes exceedingly small. This paper, if properly made, is very useful for all ordinary photogenic purposes. For example, nothing can be more perfect than the images it gives of leaves and flowers, especially with a summer sun. The light passing through the leaves delineates every ramification of their nerves. If a sheet of paper thus prepared, be taken and washed with a *saturated* solution of salt, and then dried, it will be found (especially if the paper has been kept some weeks before the trial is made) that its sensibility is greatly diminished, and in some cases seems quite extinct. But if it be again washed with a liberal quantity of the solution of silver, it becomes again sensible to light, and even more so than it was at first. In this way, by alternately washing the paper with salt and silver, and drying it between times, Mr. Talbot has succeeded in increasing its sensibility to the degree that is requisite for receiving the images of the camera obscura. In conducting this operation it will be found that the results are sometimes more and sometimes less satisfactory in consequence of small and accidental variations in the proportions employed. It happens sometimes that the chloride of silver is disposed to darken of itself without any exposure to the light: this shows that the attempt to give it sensibility has been carried too far. The object is, to *approach* to this condition as near as possible, without *reaching* it, so that the substance may be in a state ready to yield to the slightest extraneous force, such as the feeble impact of the violet rays when much attenuated. Having therefore prepared a number of sheets of paper slightly different from one another in the composition, let a piece be cut from each, and having been duly marked or numbered, let them be placed side by side in a very weak diffused light for about a quarter of an hour. Then, if any one of them, as frequently happens, exhibits a marked advantage over its competitors, Mr. Talbot selects the paper which bears the corresponding number, to be placed in the camera obscura.

With regard to the second object, that of fixing the images, Mr. Talbot observed that after having tried *ammonia* and several other reagents, with very imperfect success, the first which gave him a successful result was the iodide of potassium much diluted with water. If a photogenic picture is washed over with this liquid, an *iodide of silver* is formed, which is absolutely unalterable by sunshine. This process requires precaution; for, if the solution is too strong, it attacks the dark parts of the picture. It is requisite therefore to find by trial the proper proportions. The fixation of the pictures in this way, with proper management, is very beautiful and lasting. The

specimen of *lace* which Mr. Talbot exhibited to the Society, and which was made five years ago, was preserved in this manner. But his usual method of fixing is different from this, and somewhat simpler, or at least, requiring less nicety. It consists in immersing the picture in a strong solution of *common salt*, and then wiping off the superfluous moisture and drying it. It is sufficiently singular that the same substance which is so useful in *giving* sensibility to the paper, should also be capable, under other circumstances, of *destroying* it, but such is nevertheless the fact. Now, if the picture which has been thus washed and dried, is placed in the sun, the white parts colour themselves of a pale lilac tint; after which they become insensible. Numerous experiments have shown the author, that the depth of this lilac tint varies according to the quantity of salt used relatively to the quantity of silver. But by properly adjusting these, the images may, if desired, be retained of an absolute whiteness. He mentions also, that those preserved by *iodine* are always of a very pale primrose yellow, which has the extraordinary and very remarkable property of turning to a full gaudy yellow whenever it is exposed to the heat of a fire, and recovering its former colour again when it is cold.

A paper was also read, entitled, "A Description of a Hydro-pneumatic Baroscope." By J. T. Cooper, Esq., Lecturer on Chemistry.

The liability of the ordinary mercurial barometer to derangement and to fracture, led the author to the construction of an instrument for measuring atmospheric pressure that should be exempt from these objections. It consists of a float, formed by a brass tube, having the shape of the frustum of an inverted cone, nine inches long, two inches in diameter above, and one inch below, and its content being about fourteen cubic inches. From the centre of the upper and wider end, which is closed, a brass wire proceeds, surmounted by a cup, for the purpose of holding such weights as are necessary for bringing the float, when immersed in water, to the same constant level. The lower and smaller end of the tube is closed by a brass plug, sufficiently heavy to sink the instrument to the proper depth, and maintain its position, and having a small perforation in its centre. This float is inclosed in a case, containing the water in which it is to be immersed, and which is to be raised to a constant given temperature by a spirit lamp burning beneath it. The float being first filled with water, a given portion of this water is poured out into a measure of known capacity, and is consequently replaced by an equal volume of air, the dilatations or contractions of which will, when the temperature is constant, be dependent only on the external pressure of the atmosphere; and the latter will, therefore, be indicated by the weights requisite to be placed in the cup of the float, in order to maintain it at the same level in the fluid, on the principle of the hydrometer. The author gives a minute description of all the parts of the apparatus, of the method of using it, and of the adjustments and calculations required for determining by its means the difference of level of two stations.

Mr. Darwin's paper, entitled, "On the Parallel Roads of Glen Roy, and other parts of Lochaber, &c.," was resumed, but not concluded.

February 28, 1839.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treas., in the Chair.

Commander Henry Mangles Denham, R.N., and Richard Drew, Esq., were balloted for, and duly elected into the Society.

The reading of a paper, entitled, "Observations on the Parallel Roads of Glen Roy, and of other parts of Lochaber, with an attempt to prove that they are of Marine Origin." By Charles Darwin, Esq., M.A., F.R.S., Sec. Geological Society, was resumed and concluded.

The author premises a brief description of the parallel roads, shelves, or lines, as they have been indefinitely called, which are most conspicuous in Glen Roy and the neighbouring valleys, referring for more detailed accounts to those given by Sir Thomas Lauder Dick, in the Transactions of the Royal Society of Edinburgh, and by Dr. Macculloch in those of the Geological Society of London. Both these geologists endeavour to explain the formation of these shelves on the hypothesis of their resulting from depositions at the margin of lakes, which had formerly existed at those levels. The author, however, shows that this hypothesis is inadmissible, from the insuperable difficulties opposed to any conceivable mode of the construction and removal, at successive periods, of several barriers of immense size, whether placed at the mouths of the separate glens, or at more distant points. He does not, however, propose the alternative, that the beaches, if not deposited by lakes, must of necessity have been formed by channels of the sea, because he deems it more satisfactory to prove, from independent phenomena, that a sheet of water, gradually subsiding from the height of the upper shelves to the present level of the sea, occupied for long periods not only the glens of Lochaber, but the greater number, if not all the valleys of that part of Scotland; and that this water must have been that of the sea. It is argued by the author, that the fluctuating element must have been the land, from the ascertained fact of the land rising in one part, and at the same time sinking in another; and therefore, that this change of level in Scotland, attested as it is by marine remains being found at considerable heights both on the eastern and western coasts, implies the elevation of the land, and not the subsidence of the surrounding waters. The author next shows, that in all prolonged upward movements of this kind, it might be predicted, both from the analogy of volcanic action, and from the occurrence of lines of escarpment rising one above the other in certain regions, that in the action of the subterranean impulses there would be intervals of rest. On the hypothesis that the

land was subjected to these conditions, it appears that its surface would have been modeled in a manner exactly similar, even in its minute details, to the existing structure of the valleys in Lochaber. Considering that he has thus established his theory, the author proceeds to remove the objections which might be urged against its truth, derived from the non-extension of the shelves, and the absence of organic remains at great altitudes. He then shows how various details respecting the structure of the glens of Lochaber, such as the extent of corrosion of the solid rock, the quantity of shingle, the numerous levels at which water must have remained, the forms of the heads of the valley, where the streams divide, and especially their relation with the shelves, and the succession of terraces near the mouth of Glen Spean, are all explicable on the supposition that the valleys had become occupied by arms of a sea which had been subject to tides, and which had gradually subsided during the rising of the land; two conditions which could not be fulfilled in any lake. From the attentive consideration bestowed by the author on these several and independent steps of the argument, he regards the truth of the theory of the marine origin of the parallel roads of Lochaber (a theory, of which the foundation stone may be said to have been laid by the important geological researches of Mr. Lyell, establishing the fact of continents having slowly emerged from beneath the sea) as being sufficiently demonstrated.

The author states, in the concluding part of his paper, the following as being the chief points which receive illustration from the examination of the district of Lochaber by Sir Thomas Lauder Dick, Dr. Macculloch, and himself. It appears that nearly the whole of the water-worn materials in the valleys of this part of Scotland were left, as they now exist, by the slowly retiring waters of the sea; and the principal action of the rivers since that period has been to remove such deposits; and when this had been effected, to excavate a wall-sided gorge in the solid rock. Throughout this entire district, every main, and most of the lesser inequalities of surface are due, primarily to the elevating forces, and, secondarily, to the modeling power of successive beach-lines. The ordinary alluvial action has been exceedingly insignificant; and even moderately sized streams have worn much less deeply into the solid rock than might have been anticipated, during the vast period which must have elapsed since the sea was on a level with the upper shelves: even the steep slopes of turf over large spaces, and the bare surface of certain rocks, having been perfectly preserved during the same lapse of time. The elevation of this part of Scotland to the amount of at least 1278 feet was extremely gradual, and was interrupted by long intervals of rest. It took place either during the so called "erratic block period," or afterwards; and it is probable that the erratic blocks were transported during the quiet formation of the shelves. One of these was found at an altitude of 2200 feet above the present level of the sea. The most extraordinary fact is, that a large tract of country was elevated to a great height, so equably, that the ancient beach-lines retain the same curvature, or nearly so, which they had when forming the margin of the convex surface of the ancient waters.

The inferences drawn by the author from these facts, and which he corroborates by other evidence, are that a large area must have been uplifted, and that its rise was effected by a slight change in the convex form of the fluid matter on which the crust of the earth rests; and therefore that the fluidity of the former is sufficiently perfect to allow of the atoms moving in obedience to the law of gravitation, and consequently, of the operation of that law modified by the centrifugal force: and lastly, that even the disturbing forces do not tend to give to the earth a figure widely different from that of a spheroid in equilibrium.

March 7, 1839.

The MARQUIS of NORTHAMPTON, President, in the Chair.

George Godwin, jun. Esq., and George Gulliver, Esq., were balloted for, and duly elected into the Society.

A paper was read, entitled, "On the Male Organs of some of the Cartilaginous Fishes." By John Davy, M.D., F.R.S., Assistant Inspector of Army Hospitals.

In this paper, which is wholly occupied with anatomical details, the author refers to his paper on the Torpedo, which was published in the Philosophical Transactions for 1834; and also to Müller's work "De Glandularum secernentium structura penitiori," whose descriptions and views are not in accordance with those given in that paper. In the present memoir he adduces evidence of the accuracy of his former statement, chiefly founded on microscopical observations, and offers some conjectures respecting the functions of several organs found in cartilaginous fishes; but does not pretend to attach undue importance to his speculations.

A paper was also read, entitled, "Researches in Physical Geology.—*Third Series.* On the Phenomena of Precession and Nutation, assuming the interior of the earth to be a heterogeneous fluid." By W. Hopkins, Esq., M.A., F.R.S., &c.

Having, in his last memoir, completed the investigation of the amount of precession and nutation, on the hypothesis of the earth's consisting of a homogeneous fluid mass, contained in a homogeneous solid shell, the author here extends the inquiry to the case in which both the interior fluid and external shell are considered as heterogeneous. After giving the details of his analytical investigation, he remarks, that he commenced the inquiry in the expectation that the solution of this problem would lead to results different from those previously obtained on the hypothesis of the earth's entire solidity. This expectation was founded on the great difference existing between the direct action of a force on a solid, and that on a fluid mass, in its tendency to produce a rotatory motion; for, in fact, the disturbing forces of the sun and moon do not tend to produce directly

any motion in the interior fluid, in which the rotatory motion causing precession and nutation is produced indirectly by the effect of the same forces on the position of the solid shell. A modification is thus produced in the effects of the centrifugal force, which exactly compensates for the want of any direct effect from the action of the disturbing forces; a compensation which the author considers as scarcely less curious than many others already recognized in the solar system, and by which, amidst many conflicting causes, its harmony and permanence are so beautifully and wonderfully preserved.

The solution of the problem obtained by the author destroys the force of an argument, which might have been urged against the hypothesis of central fluidity, founded on the presumed improbability of our being able to account for the phenomena of precession and nutation on this hypothesis, as satisfactorily as on that of internal solidity. The object, however, of physical researches of this kind is not merely to determine the actual state of the globe, but also to trace its past history through that succession of ages, in which the matter composing it has probably passed gradually through all the stages between a simple elementary state and that in which it has become adapted to the habitation of man. In this point of view the author conceives the problem he proposes is not without value, as demonstrating an important fact in the history of the earth, presuming its solidification to have begun at the surface; namely, the permanence of the inclination of its axis of rotation, from the epoch of the first formation of an exterior crust. This permanence has frequently been insisted on, and is highly important as connected with the speculations of the author on the causes of that change of temperature which has probably taken place in the higher latitudes: all previous proofs of this fact having rested on the assumption of the earth's entire solidity; an assumption which, whatever may be the actual state of our planet, can never be admitted as applicable to it at all past epochs of time, at which it may have been the habitation of animate beings.

The author concludes, by expressing a hope that he may be enabled to prosecute the inquiry still further, and to bring before the Royal Society, at a future time, the matured results of his speculations.

March 14, 1839.

JOHN W. LUBBOCK, Esq., Vice-President and Treas., in the Chair.

G. W. Featherstonhaugh, Esq., who at the last Anniversary had ceased to be a Fellow from the non-payment of his annual contribution, was, at this Meeting, re-admitted by ballot into the Society, agreeably to the provision of the Statutes.

Clement Tudway Swanston, Esq., was balloted for, and duly elected into the Society.

A paper was read, entitled, "An Experimental Inquiry into the

Formation of Alkaline and Earthy Bodies, with reference to their presence in Plants, the Influence of Carbonic Acid in their generation, and the equilibrium of this gas in the atmosphere." By Robert Rigg, Esq. Communicated by the Rev. J. B. Reade, M,A., F.R.S.

The object of the author, in the present memoir, is to show that the solid materials which compose the residual matter in the analysis of vegetable substances, and which consist of alkaline and earthy bodies, are actually formed during the process of fermentation, whether that process be excited artificially, by the addition of a small quantity of yeast to fermentable mixtures, or take place naturally in the course of vegetation, or of spontaneous decomposition. His experiments also tend to show that this formation of alkaline and earthy bodies is always preceded by the absorption of carbonic acid, whether that acid be naturally formed or artificially supplied. He finds, also, that different kinds of garden mould, some being calcareous, others siliceous, and others aluminous, exposed in retorts to atmospheres consisting of a mixture of carbonic acid gas and common air, absorb large quantities of the former, combining with it in such a manner as not to afford any traces of this carbonic acid being disengaged by the action of other acids. He considers the result of this combination to be the formation of an alkaline body, and also of a colouring matter. This combination takes place to a greater extent during the night than during the day; and in general, the absorption of carbonic acid by the soil is greatest in proportion as it is more abundantly produced by the processes of vegetation; and conversely, it is least at the time when plants decompose this gas, appropriating its basis to the purposes of their own system. Hence he conceives that there is established in nature a remarkable compensating provision, which regulates the quantity of carbonic acid in the atmosphere, and renders its proportion constant.

A paper was also read, entitled, "Note on the Art of Photography, or the application of the Chemical Rays of Light to the purposes of Pictorial Representation." By Sir John F. W. Herschel, Bart., K.H., V.P.R.S., &c.

The author states that his attention was first called to the subject of M. Daguerre's concealed photographic processes, by a note from Captain Beaufort, dated the 22nd of January last, at which time he was ignorant that it had been considered by Mr. Talbot, or by any one in this country. As an enigma to be solved, a variety of processes at once presented themselves, of which the most promising are the following; 1st, the so-called de-oxidizing power of the chemical rays in their action on recently precipitated chloride of silver; 2ndly, the instant and copious precipitation of a mixture of a solution of muriate of platina and lime-water by solar light, forming an insoluble compound, which might afterwards be blackened by a variety of agents; 3rdly, the reduction of gold in contact with deoxidizing agents; and, 4thly, the decomposition of an argentine compound soluble in water, exposed to light in an atmosphere of peroxide of chlorine, either pure or dilated.

Confining his attention, in the present notice, to the employment of chloride of silver, the author inquires into the methods by which the blackened traces can be preserved, which may be effected, he observes, by the application of any liquid capable of dissolving and washing off the unchanged chloride, but of leaving the reduced, or oxide of silver, untouched. These conditions are best fulfilled by the liquid hyposulphites. Pure water will fix the photograph, by washing out the nitrate of silver, but the tint of the picture resulting is brick-red; but the black colour may be restored by washing it over with a weak solution of hyposulphite of ammonia.

The author found that paper impregnated with the chloride of silver was only slightly susceptible to the influence of light: but an accidental observation led him to the discovery of other salts of silver, in which the acid being more volatile, adheres to the base by a weak affinity, and which impart much greater sensibility to the paper on which they are applied: such as the carbonate, the nitrate, and the acetate. The nitrate requires to be perfectly neutral; for the least excess of acid lowers in a remarkable degree its susceptibility.

In the application of photographic processes to the copying of engravings or drawings, many precautions, and minute attention to a number of apparently trivial, but really important circumstances, are required to ensure success. In the first tranfers, both light and shadow, as well as right and left, are the reverse of the original: and to operate a second transfer, or by a double inversion to reproduce the original effect, is a matter of infinitely greater difficulty; and in which the author has only recently ascertained the cause of former failures, and the remedy to be applied.

It was during the prosecution of these experiments that the author was led to notice some remarkable facts relating to the action of the chemical rays. He ascertained that, contrary to the prevailing opinion, the chemical action of light is by no means proportional to the quantity of violet rays transmitted, or even to the general tendency of the tint to the violet end of the spectrum: and his experiments lead to the conclusion that, in the same manner as media have been ascertained to have relations *sui generis* to the calorific rays, not regulated by their relations to the rays of illumination and of colour, they have also specific relations to the chemical spectrum, different from those they bear to the other kinds of spectra. For the successful prosecution of this curious investigation, the first step must consist in the minute examination of the chemical actions of all the parts of a pure spectrum, not formed by material prisms, and he points out, for that purpose, one formed in Fraunhofer's method, by the interference of the rays of light themselves in passing through gratings, and fixed by the heliostat.

He notices a curious phenomenon respecting the action of light on nitrated paper; namely, its great increase of intensity, under a certain kind of glass strongly pressed in contact with it; an effect which cannot be explained either by the reflection of light, or the presence of moisture; but which may possibly be dependent on the evolution of heat.

Twenty-three specimens of photographs, made by Sir John Her-

schel, accompany this paper: one, a sketch of his telescope at Slough, fixed from its image in a lens; and the rest copies of engravings and drawings, some reverse, or first transfers; and others second transfers or re-reversed pictures.

March 21, 1839.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Thomas William Fletcher, Esq., and the Rev. Thomas Gaskin, were balloted for, and duly elected into the Society.

The following papers were read:—

I. "Description of a Compensating Barometer, adapted to Meteorological purposes, and requiring no corrections either for Zero, or for Temperature." By Samuel B. Howlett, Esq., Chief Military Draftsman, Ordnance. Communicated by Sir John F. W. Herschel, Bart., K.H., V.P.R.S., &c.

In the instrument here described, there is provided, in addition to the ordinary barometric tube (inverted, in the usual way, in a cistern of mercury,) a second tube of the same dimensions, placed by the side of the former, and likewise filled with mercury, but only to the height of twenty-eight inches above the level of the mercury of the cistern. This tube is closed at its lower end, and fixed to a float supported by the mercury in the cistern: and it bears, at its upper end, an ivory scale, three inches in length. The elevation of the mercury in the barometric tube is estimated by the difference between its level and that of the mercury in the closed tube; and is measured on the ivory scale by the aid of a horizontal index, embracing both the tubes, and sliding vertically along them. As the float which bears the closed tube, to which the scale is attached, rests freely on the mercury in the cistern, and consequently always adjusts itself to the level of that fluid, no correction for the zero point is needed; and as every change of temperature must similarly affect the columns of mercury in both the tubes, after the scale has been adjusted so as to read correctly at any given temperature, such as 32°, which may be effected by comparison with a standard barometer, every other reading will correspond to the same temperature, and will require no correction. The author considers the error arising from the difference of expansion corresponding to the different lengths of the two columns of mercury, and which will rarely amount to one four-hundredth of an inch, as too small to deserve attention in practice, being, in fact, far within the limits of error in ordinary observations.

Subjoined to the above paper is a letter from the author to Sir John Herschel, containing a statement of comparative observations made with a mountain barometer, and with the compensation barometer, from which it appears that the use of the latter is attended with the saving of a great quantity of troublesome calculation. The comparative observations are given in a table, exhibiting a range of differences from $+\cdot012$ to $-\cdot016$ of an inch.

II. "An Account of the fall of a Meteoric Stone in the Cold Bokkeveld, Cape of Good Hope." By Thomas Maclean, Esq., F.R.S., &c., in a letter to Sir John F. W. Herschel, Bart., V.P.R.S., and communicated by him.

The appearance attending the fall of this aerolite, which happened at half-past nine o'clock in the morning of the 13th of October, 1838, was that of a meteor of a silvery hue, traversing the atmosphere, for a distance of about sixty miles, and then exploding with a loud noise, like that from artillery, which was heard over an area of more than seventy miles in diameter; the air at the time being calm and sultry. The fragments were widely dispersed; and were at first so soft as to admit of being cut with a knife; but they afterwards spontaneously hardened. The entire mass of the aerolite is estimated at about five cubic feet.

III. "Chemical Account of the Cold Bokkeveld Meteoric Stone." By Michael Faraday, Esq., D.C.L., F.R.S., &c., in a letter to Sir John F. W. Herschel, Bart., V.P.R.S., &c., and communicated by him.

The stone is stated as being soft, porous, and hygrometric; having when dry, the specific gravity of 2·94; and possessing a very small degree of magnetic power irregularly dispersed through it. One hundred parts of the stone, in its natural state, was found to consist of the following constituents; namely,

Water	6·5	Alumina........	5·22
Sulphur	4·24	Lime	1·64
Silica	28·9	Oxide of Nickel..	·82
Protoxide of Iron....	33·22	Oxide of Chromium	·7
Magnesia..........	19·2	Cobalt and Soda..	a trace.

IV. "Note respecting a new kind of Sensitive Paper." By Henry Fox Talbot, Esq., F.R.S.

The method of preparing the paper here referred to consists in washing it over with nitrate of silver, then with bromide of potassium, and afterwards again with nitrate of silver; drying it at the fire after each operation. This paper is very sensitive to the light of the clouds, and even to the feeblest daylight.

The author supplies an omission in his former memoir on photogenic drawing, by mentioning a method he had invented and practised nearly five years ago, of imitating etchings on copper plate, by smearing over a sheet of glass with a solution of resin in turpentine, and blackening it by the smoke of a candle. On this blackened surface a design is made with the point of a needle, the lines of which will of course be transparent, and will be represented by dark lines on the prepared paper to which it is applied, when exposed to sunshine. The same principle may be applied to make numerous copies of any writing.

The Society then adjourned over the Easter Recess, to meet again on the 11th of April next.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1839. No. 38.

April 11, 1839.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Lieutenant H. Alexander Ormsby, I. N., was balloted for, and duly elected into the Society.

A paper was read, entitled, " On a new equi-atomic compound of Bicyanide with Binoxide of Mercury." By James F. W. Johnston, Esq., F.R.S.

In this paper an account is given of the properties of a salt, obtained by agitating with red oxide of mercury a small proportion of hydrocyanic acid, and which the author finds to be distinguished from the bicyanide of mercury by its sparing solubility in cold water, by the strong alkaline reaction exhibited by its solution, (a property which indicates an excess of mercury,) and by its susceptibility of detonation by heat, depending on this excess being in the state of an oxide, and on the action of the oxygen on a portion of the carbon of the cyanogen it contains, and the presence of which is shown by the disengagement of hydrocyanic acid gas when acted on by hydrosulphuric and hydrochloric acids.

The analysis of this salt, given by the author, shows it to consist of

Carbon..........	5·203
Nitrogen........	6·025
Oxygen	3·098
Mercury	85·674
	100.

The formula of which composition is as follows:

$$\text{Hg. Cy.}_2 + \text{Hg. O.}_2$$

April 18, 1839.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treas., in the Chair.

John Thomas Graves, Esq., M.A., and the Rev. Samuel Roffey Maitland, were balloted for, and duly elected into the Society.

The ballot for James Joseph Sylvester, Esq., was postponed in consequence of the number of Fellows required by the charter not being present.

The following papers were read, viz.—

"On the Constitution of the Resins." *Part I.* By James F. W. Johnston, Esq., F.R.S.

The object of the general investigation, of which the commencement is given in this paper, is to determine the relative composition of the various resins which occur in nature, and to trace the analogies they exhibit in their constitution; and also to ascertain how far they may be regarded as being derived from one common principle, and whether they admit of being all represented by one or more general formulæ.

The chemical investigation of the resin of mastic shows that this substance consists of two resins; the one soluble, and acid; the other insoluble, and having no acid properties. The formulæ expressing the analysis of each of these are given by the author. He also shows that a series of analyses may be obtained which do not indicate the true constitution of a resin. The soluble resin, when exposed to the prolonged action of a heat exceeding 300° Fahr. is partly converted into a resin containing three, and partly into one containing five equivalent parts of oxygen, the proportion of carbon remaining constant. The same resin combines with bases, so as to form four series of salts; which, in the case of oxide of lead, consist of equivalents of resin and of oxide in the proportions, respectively, of two to one; three to two; one to one; and one to two. This soluble resin in combining with bases does not part with any of its oxygen; but if any change takes place in its constitution, it consists in the hydrogen being replaced by an equivalent proportion of a metal; and formulæ are given representing the salts of lead on this theoretical view. By boiling the resin in contact with ammonia and nitrate of silver, or perhaps with nitrate of ammonia, it is converted into a resin which forms a bisalt with oxide of silver, in which there is also an apparent replacement of hydrogen by silver.

The resin next examined is that of dragon's blood: and the conclusions deduced from its analysis are the following. First, that the lump dragon's blood is the natural and pure resin, while the strained and red varieties, being manufactured articles, are more or less decomposed: secondly, that this resin retains alcohol and ether, as most other resins do, with considerable tenacity; but that these solvents may be entirely expelled by a long-continued exposure to a temperature not higher than 200° Fahr.: and lastly, the formulæ representing its chemical composition is given.

"Researches in Embryology." — *Second Series.* By Martin Barry, M.D., F.R.S.E., Fellow of the Royal College of Physicians in Edinburgh. Communicated by P. M. Roget, M.D. Sec. R.S.

The author having, in the first series of these researches, investigated the formation of the mammiferous ovum, describes in this second series its incipient developement. The knowledge at present

supposed to be possessed of the early stages in the developement of that ovum, consists chiefly of inferences from observations made on the ovum of the bird.

But there exists a period in the history of the ovum of the mammal, regarding which we have hitherto scarcely any direct or positive knowledge. It appeared, therefore, highly desirable to obtain a series of observations in continuous succession on the earliest stages of developement. In conducting this investigation, the author purposely confined his attention to a single species, namely, the rabbit, of which he examined more than a hundred individual animals. Besides ova met with in the ovary, apparently impregnated, and destined to be discharged from that organ, he has seen upwards of three hundred ova in the Fallopian tube and uterus; very few of the latter exceeding half a line in their diameter. The results of these investigations have compelled the author to express his dissent from some of the leading doctrines of embryology, which at present prevail, as respects not only the class Mammalia, but the animal kingdom at large. The following are the principal facts which the author has observed in the developement of the mammiferous ovum.

The difference between the mature and immature ovum consists in the condition of the yelk; the yelk of the mature ovum containing no oil-like globules. Both maceration and incipient absorption produce changes in the unimpregnated ovum, which in some respects resemble those referable to impregnation. During the rut, the number of Graafian vesicles appearing to become prepared for discharging their ova, exceeds the number of those which actually discharge them. Ova of the rabbit which are destined to be developed, are in most instances discharged from the ovary in the course of nine or ten hours *post coitum*; and they are all discharged about the same time.

There is no condition of the ovum uniform in all respects which can be pointed out as the particular state in which it is discharged from the ovary; but its condition is in several respects very different from that of the mature ovum *ante coitum*. Among the changes occurring in the ovum before it leaves the ovary, are the following: viz. the germinal spot, previously on the inner surface, passes to the centre of the germinal vesicle; the germinal vesicle, previously at the surface, returns to the centre of the yelk; and the membrane investing the yelk, previously extremely thin, suddenly thickens. Such changes render it highly probable that the ovary is the usual seat of impregnation. The author considers this view as being not incompatible with the doctrine that contact between the seminal fluid and the ovum is essential to impregnation, since he has found, in the course of his researches, that spermatozoa penetrate as far as to the surface of the ovary. The retinacula and tunica granulosa are the parts acted upon by the *vis a tergo*, which expels the ovum from the ovary. These parts are discharged with the ovum, render its escape gradual, probably facilitate its passage into the Fallopian tube, and appear to be the bearers of fluid for the immediate imbibition of the ovum. After the discharge of the ovum from the ovary, the ovisac is obtainable free from the vascular covering, which, together

with the ovisac, had constituted the Graafian vesicle. It is the vascular covering of the ovisac which becomes the corpus luteum. Many ova, both mature and immature, disappear at this time by absorption. In some animals minute ovisacs are found in the infundibulum, the discharge of which from the ovary appears referable to the rupture of large Graafian vesicles, in the parietes or neighbourhood of which those ovisacs had been situated.

The diameter of the rabbit's ovum, when it leaves the ovary, does not generally exceed the 135th part of an inch, and in some instances it is still smaller. The ovum enters the uterus in a state very different from that in which it leaves the ovary; hence the opinion, that "in their passage through the tube the ova of Mammalia undergo scarcely any metamorphosis at all," is erroneous. Among the changes taking place in the ovum during its passage through the Fallopian tube are the following; viz. 1. An outer membrane, the chorion, becomes visible. 2. The membrane originally investing the yelk, which had suddenly thickened, disappears by liquefaction; so that the yelk is now immediately surrounded by the thick transparent membrane of the ovarian ovum. 3. In the centre of the yelk, that is, in the situation to which the germinal vesicle returned before the ovum left the ovary, there arise several very large and exceedingly transparent vesicles: these disappear, and are succeeded by a smaller and more numerous set; several sets thus successively come into view, the vesicles of each succeeding set being smaller than the last, until a mulberry-like structure has been produced, which occupies the centre of the ovum. Each of the vesicles of which the surface of the mulberry-like structure is composed contains a pellucid nucleus; and each nucleus presents a nucleolus.

In the uterus a layer of vesicles of the same kind as those of the last and smallest set here mentioned makes its appearance on the whole of the inner surface of the membrane which now invests the yelk. The mulberry-like structure then passes from the centre of the yelk to a certain part of that layer, (the vesicles of the latter coalescing with those of the former where the two sets are in contact to form a membrane,) and the interior of the mulberry-like structure is now seen to be occupied by a large vesicle containing a fluid and granules. In the centre of this vesicle is a spherical body having a granulous appearance, and containing a cavity apparently filled with a colourless and pellucid fluid. This hollow spherical body seems to be the true germ. The vesicle containing it disappears, and in its place is seen an elliptical depression filled with a pellucid fluid. In the centre of this depression is the germ, still presenting the appearance of a hollow sphere. The germ separates into a central and a peripheral portion, the central portion occupies the situation of the future brain, and soon presents a pointed process which is the rudiment of the spinal cord. These parts at first appearing granulous are subsequently found to consist of vesicles.

Thus the central portion of the nervous system is not originally a fluid contained within a tube, but developes itself in a solid

form before any other part. The central portion of the nervous system sometimes attains a considerable degree of developement, although it be exceedingly minute; thus an instance has been met with in which the developement of this part had reached a stage scarcely inferior to that in another instance, in which the corresponding part measured more than ten times the length.

There does not occur in the mammiferous ovum any such phenomenon as the "splitting" of a membrane into the so-called "serous, vascular, and mucous laminæ." Rathke had already found that parts previously supposed by Baer and others to be formed by the so-called "germinal membrane," really originate independently of it: these parts are the ribs, pelvic bones, and the muscles of the thorax and abdomen, which according to Rathke arise in a part proceeding out of the "primitive trace" itself. Reichert had previously discovered that the part originating the lower jaw and hyoid bone "grows out of the primitive trace." The author beginning with an earlier period goes farther than these observers, and shows that the so-called "primitive trace" itself does not arise in the substance of a membrane, but presents a comparatively advanced stage of the object above described as the true germ. Hence the author suggests, there is no structure entitled to be denominated the "germinal membrane."

The most important of the foregoing facts respecting the developement of the mammiferous ovum, however opposed they may be to received opinions, are in accordance with, and may even explain, many observations which have been made on the developement of other animals as recorded in the delineations of preceding observers. If in the ovum of the bird the germinal vesicle in like manner returns to the centre of the yelk, the canal and cavity known to exist in the yelk of that ovum might be thus explained. The ovum may pass through at least one-and-twenty stages of developement, and contain, besides the embryo, four membranes, one of which has two laminæ, before it has itself attained the diameter of half a line, a fifth membrane having disappeared by liquefaction within the ovum.

The size of the minute ovum in the Fallopian tube and uterus affords no criterion of the degree of its developement; nor do any two parts of the minute ovum, in their developement, necessarily keep pace with one another.

The proportion of ova met with in these researches, which seemed to be abortive, has amounted to nearly one in eight. Sometimes two yelk-balls exist in the same ovum. With slight pressure, the ovum, originally globular, becomes elliptical. Its tendency to assume the latter form exists especially in the chorion, and seems to be in proportion to its size.

The author has discovered that when the germinal vesicle is first seen it is closely invested by an extremely delicate membrane. This membrane subsequently expanding is that in which the yelk is formed. He has traced the chorion from stage to stage up to the period when it becomes villous, and shows that it is not, as he formerly supposed, the thick transparent membrane itself of the ovarian

ovum, but a thin envelope closely investing that membrane, and not appreciable as a distinct structure until the ovum has been crushed. When the chorion first admits of demonstration as a distinct structure the ovum consists of three membranes, a state which the author has seen in an ovum no farther advanced than about an inch into the Fallopian tube. The chorion subsequently thickens and imbibes a quantity of fluid presenting a gelatinous appearance.

April 25, 1839.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Robert Rigg, Esq. and James Joseph Sylvester, Esq. were balloted for, and duly elected into the Society.

A paper was in part read, entitled, "Account of Experiments on Iron-built Ships, instituted for the purpose of discovering a Correction for the Deviation of the Compass produced by the Iron of Ships." By George Biddell Airy, Esq., M.A., F.R.S., A.R.

May 2, 1839.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Arthur Farre, M.B., was balloted for, and duly elected into the Society.

A paper was in part read, entitled, "On the Motion of the Blood." By James Carson, M.D., F.R.S.

May 9, 1839.

The MARQUIS of NORTHAMPTON, President, in the Chair.

William Sharpey, M.D. and the Rev. Charles Turnor, M.A. were balloted for, and duly elected into the Society.

The reading of a paper, entitled, "On the Motion of the Blood." By James Carson, M.D., F.R.S., was resumed and concluded.

After referring to his paper contained in the Philosophical Transactions for 1820, relative to the influence of the elasticity of the lungs as a power contributing to the effectual expansion of the heart, and promoting the motion of the blood in the veins, the author states that his object in this paper is to explain more fully the mode in which these effects are produced, and to corroborate by additional

facts and observations the arguments adduced in its support. He endeavours, from a review of the circumstances under which the veins are placed, to show the inconclusiveness of the objections which have been urged by various physiologists against his and the late Sir David Barry's theory of suction: namely, that the sides of a pliant vessel, when a force of suction is applied, will collapse and arrest the further transmission of fluid though that channel. The considerations which he deems adequate to give efficacy to the power of suction in the veins of a living animal are, first, the position of the veins by which, though pliant vessels, they acquire in some degree the properties of rigid tubes; secondly, the immersion of the venous blood in a medium of a specific gravity at least equal to its own; thirdly, the constant introduction of recrementitious matter into the venous system at its capillary extremities by which the volume of the venous blood is increased, and its motion urged onwards to the heart in distended vessels; and lastly, the gravity of the fluid itself, creating an outward pressure at all parts of the veins below the highest level of the venous system. The author illustrates his positions by the different quantities of blood which are found to flow from the divided vessels of an ox, according to the different modes in which the animal is slaughtered.

The reading of a paper, entitled, "Account of Experiments on Iron-built Ships, instituted for the purpose of discovering a Correction for the Deviation of the Compass produced by the Iron of the Ships." By George Biddell Airy, Esq., A.M., F.R.S., Astronomer Royal, was also resumed and concluded.

In this paper the problem of the deviation of a ship's compass, arising from the influence of the iron in the ship, more particularly in iron-built ships, is fully investigated; and the principles on which the correction for this deviation depends having been determined, practical methods for neutralizing the deviating forces are deduced and illustrated by experimental application. The author states that, for the purpose of ascertaining the laws of the deviation of the compass in the iron-built steam-ship the Rainbow, four stations were selected in that vessel, about four feet above the deck, and at these the deviations of the horizontal compasses were determined in the various positions of the ship's head. All these stations were in the vertical plane, passing through the ship's keel, three being in the after part of the ship and one near the bow. Observations were also made for determining the horizontal intensity at each of the stations. The deviations of dipping needles at three of these stations were also determined, when the plane of vibration coincided with that of the ship's keel, and also when at right angles to it.

After describing the particular method of observing rendered necessary by the nature of the vessel and the circumstances of her position, the author gives the disturbance of the horizontal compass at the four stations deduced from the observations. The most striking features in these results are, the very great apparent change in the direction of the ship's head, as indicated by the compass nearest

the stern, corresponding to a small real change in one particular position, the former change being 97°, whereas the latter was only 23°, and the small amount of disturbance indicated by the compass near the bow.

After giving the observations for the determination of the influence of the ship on the horizontal intensity of a needle suspended at each of the stations, in four different positions of the ship's head, and the disturbances of the dipping needle at three of these stations, the author enters upon the theoretical investigation.

The fundamental supposition of the theory of induced magnetism, on which Mr. Airy states his calculations to rest, is, that, by the action of terrestrial magnetism, every particle of iron is converted into a magnet, whose direction is parallel to that of the dipping needle, and whose intensity is proportional to that of terrestrial magnetism, the upper end having the property of attracting the north end of the needle, and the lower end that of repelling it.

The attractive and repulsive forces of a particle on the north end of the needle, in the directions of rectangular axes towards north, towards east, and vertically downwards, and of which the compass is taken as the origin, are first determined on this supposition in terms of the co-ordinates; and thence the true disturbing forces of the particle in these directions. The disturbing forces produced by the whole of the iron of the ship are the sums of the expressions for every particle. Expressing this summation by the letter S, and transforming the rectangular into polar co-ordinates, Mr. Airy gives to the expressions for the disturbing forces the simplifications which they admit of, on the supposition that the compass is in the vertical plane passing through the ship's keel, and that the iron is symmetrically disposed on both sides of that plane. He thus deduces for the disturbing forces acting on the north or marked end of the needle,

$-\mathrm{I}\cos\delta.\,\mathrm{M} + \mathrm{I}\cos\delta.\,\mathrm{P}\cos 2\,\mathrm{A} + \mathrm{I}\sin\delta.\,\mathrm{N}\cos\mathrm{A}$, towards the magnetic north;

$\mathrm{I}\cos\delta.\,\mathrm{P}\sin 2\,\mathrm{A} + \mathrm{I}\sin\delta.\,\mathrm{N}\sin\mathrm{A}$, towards magnetic east;

$-\mathrm{I}\sin\delta.\,\mathrm{Q} + \mathrm{I}\cos\delta.\,\mathrm{N}\cos\mathrm{A}$, vertically downwards:

Where I represents the intensity of terrestrial magnetism; δ the dip; A the azimuth of the ship's head; and M, N, P, Q, constants depending solely on the construction of the ship, and not changing with any variations of terrestrial localities or magnetic dip or intensity.

From the consideration of these expressions for the disturbing forces is deduced the following simple rule for the correction of a compass disturbed by the induced magnetism only of the iron in a ship.

1. Determine the position of Barlow's plate with regard to the compass, which will produce the same effect as the iron in the ship.

2. Fix Barlow's plate at the distance and depression determined by the last experiment, but in the opposite azimuth.

3. Mount another mass of iron at the same level as the compass, but on the starboard or larboard side, and determine its position so

that the compass points correctly when the ship's head is N.E., S.E., S.W. or N.W.; then the compass will be correct in all positions of the ship's head, and in all magnetic latitudes.

When the disturbing iron of the ship is at the same level as the compass, the correction is stated to be much more simple, it being then only necessary to introduce a single mass of iron at the starboard or larboard side, and at the same level as the compass.

It is farther remarked that if one mass of iron is placed exactly opposite another equal mass, both in azimuth and in elevation, it doubles its disturbing effect: if one mass be placed opposite the other in azimuth, but with elevation instead of depression, or *vice versâ*, it destroys that term of the disturbance which depends on sin A, and doubles that which depends on sin 2 A: and if one mass be placed at the same level as the compass, its effects may be destroyed by placing another mass at the same level, in an azimuth differing 90° on either side. If a disturbance, from whatever cause arising, follow the law of + sin 2 A, (changing sign in the successive quadrants, and positive when the ship's head is between N. and E.), it may be destroyed by placing a mass of iron on the starboard or larboard side at the same level as the compass; if it follow the law of − sin 2 A, the mass of iron must be on the fore or aft side.

From the consideration of the expression for the disturbing forces produced by the ship, it is farther inferred, that both in the construction of the ship and in the fixing of correctors, no large mass of iron should be placed below the compass.

The expressions for the disturbing forces towards north and east, being transformed into forces towards the ship's head and towards the starboard side, give

$I \cos \delta . (-M + P) \cos A + I \sin \delta . N$, for the former, and

$I \cos \delta . (M + P)$, for the latter.

The author next proceeds to investigate the effects which result from the combination of induced magnetism with permanent magnetism. Calling H, S and V the new forces arising from the latter, and directed towards the ship's head, its starboard side, and vertically downwards, the whole disturbing force towards the ship's head becomes

$$H + I \cos \delta . (-M + P) \cos A + I \sin \delta . N;$$

and the whole disturbing force towards the starboard side,

$$S + I \cos \delta . (M + P) \sin A.$$

The manner in which the numerical values of these quantities may be found from experiment is then pointed out, and being determined from the observations on board the Rainbow, at Station I., a comparison is made between the observed disturbances of the needles, and those which would result from the action of the ship as a permanent magnet. From this comparison it appears that almost the whole disturbance is accounted for by the permanent magnetism, and that the residual part follows with sufficient approximation the law of changing signs at the successive quadrants. For the complete verification of the theory it remained only to effect an actual correction of the compass. This was done by placing below the compass, in a

position determined by the previously-ascertained numerical values, a large bar magnet to neutralize the effects of the permanent magnetism of the ship, and a roll of soft iron on one side of the compass to counteract the disturbance arising from induced magnetism. That this correction was effective appears from the very small amount of uncorrected disturbance then observed in the compass.

The observations of the compasses at stations II., III., IV., are similarly discussed: the disturbing force arising from the permanent magnetism of the ship being in like manner determined, a comparison is instituted between the observed and computed disturbance of the compass; and the results of this comparison, with the exception of the observations at Station IV., are found to be in perfect accordance with the theory. Attempts are made to correct the compasses at these stations in the same manner as at Station I., but owing to the imperfection of the compasses they did not succeed so perfectly.

The observations made with the dipping needle are next discussed, and the values of the constants are deduced from them. The general agreement of those determined from the observations when the needle vibrated in the direction of the ship's keel, with those deduced from the observations when the needle vibrated transversely, is pointed out, and is considered an additional proof of the general correctness of the theory.

Observations on the disturbance of the compass in the iron-built sailing-ship Ironsides are next described. These are similar to those in the Rainbow, but not so extensive; and they are discussed on the same principles. From this discussion it is considered that the theory is in perfect accordance with the facts observed both with regard to the deviations and the intensities. The correction of one compass was effected by a tentative process, which the author considers likely to be of the highest value in the correction of the compasses of iron-ships in general. The ship's head being placed exactly north, as ascertained by a shore compass, a magnet was placed upon the beam from which the compass was suspended, with the direction of its length exactly transverse to the ship's keel: it was moved upon the beam to various distances till the compass pointed correctly, and then it was fixed. Then the ship's head was placed exactly east, and another magnet, with its length parallel to the ship's keel, was placed upon the same beam, and moved to different distances till the compass pointed correctly, and then it was fixed. The correction for induced magnetism was neglected, but there would have been no difficulty in adjusting it by the same process, placing the vessel's head in azimuth 45° or 135° or 225° or 315°.

In conclusion Mr. Airy makes the following remarks:—

The deviations of the compass at four stations in the Rainbow, and at two stations in the Ironsides, are caused by two modifications of magnetic power; the one being the independent magnetism of the ship, which retains, in all positions of the ship, the same magnitude and the same direction relatively to the ship; the other being the induced magnetism, of which the force varies in magnitude and direction when the ship's position is changed. In the instances

mentioned, the effect of the former force was found greatly to exceed that of the latter.

It appears that experiments and observations similar to those applied in the above cases are sufficient to obtain with accuracy the constants on which at any one place the ship's action on the horizontal needle depends, namely

$$\frac{H}{I \cos \delta} + \tan \delta . N, \ \frac{S}{I \cos \delta}, \ M, \text{ and } P;$$

and that by placing a magnet so that its action shall take place in a direction opposite to that which the investigations show to be the direction of the ship's independent magnetic action, and at such a distance that its effect is equal to that of the ship's independent magnetism, and by counteracting the effect of the induced magnetism by means of the induced magnetism of another mass, according to rules which are given, the compass may be made to point exactly as if it were free from disturbance.

It appears also, that by an easy tentative method, the compass may now be corrected without the labour of any numerical investigations or any experiments except those of merely making the trials. Although the uniformity of the induced magnetism under similar circumstances is to be presumed, yet the invariability of the independent magnetism during the course of many years is by no means certain.

These statements suggest the following as rules which it is desirable to observe in the present infancy of iron-ship building. It appears desirable that

1. Every iron sea-going ship should be examined by a competent person for the accurate determination of the four constants abovementioned for each of the compasses of the ship, and a careful record of these determinations should be preserved as a magnetic register of the ship.

2. The same person should be employed to examine the vessel at different times, with the view of ascertaining whether either of the constants changes in the course of time.

3. In the case of vessels going to different magnetic latitudes, the same person should make arrangements for the examination of the compasses in other places with a view to the determination of the constant N.

4. The same person should examine and register the general construction of the ship, the position and circumstances of her building, &c., with a view to ascertain how far the values of the magnetic constants depend on these circumstances, and in particular to ascertain their connexion with the value of the prejudicial constant M.

5. The same person should see to the proper application of the correctors and the proper measures for preserving the permanency of their magnetism.

The most remarkable result in a scientific view from the experiments detailed in the present paper is, the great intensity of the permanent magnetism of the malleable iron of which the ship is composed.

May 16, 1839.

JOHN GEORGE CHILDREN, Esq., V.P., in the Chair.

A paper was read, entitled "On the visibility of certain rays beyond the ordinary red rays of the Solar Spectrum." By J. S. Cooper, Esq., in a letter to Michael Faraday, Esq., D.C.L., F.R.S., &c., &c. Communicated by Dr. Faraday.

The author states his having observed an extension of the red portion of the solar spectrum, obtained in the ordinary way, beyond the space it occupies when seen by the naked eye, by viewing it through a piece of deep blue cobalt glass. He finds that the part of the spectrum thus rendered perceptible to the right is crossed by two or more very broad lines or bands: and observes that the space occupied by the most powerful calorific rays, coincides with the situation of the red rays thus rendered visible by transmission through a blue medium. The author expresses a regret that he has not had sufficient leisure to pursue the investigation of these phænomena.

A paper was also in part read, entitled, "Fifth letter on Voltaic Combinations, with some account of the effects of a large constant Battery:" addressed to Michael Faraday, Esq., D.C.L., F.R.S., &c. By John F. Daniell, Esq., F.R.S.

The Society then adjourned over the Whitsun Recess, to meet again on the 30th instant.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1839. No. 39.

May 30, 1839.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Professors Christopher Hansteen, Macédoine Melloni, Lambert Adolphe Jacques Quételet and Felix Savart, were severally elected Foreign Members of the Society.

Edward Davies Davenport, Esq., James Orchard Halliwell, Esq., Gilbert Wakefield Mackmurdo, Esq., and the Venerable Charles Thorp, D.D., were balloted for, and duly elected into the Society.

John Howship, Esq., was balloted for, but not elected into the Society.

The reading of a paper entitled, "Fifth letter on Voltaic Combinations; with some account of the effects of a large Constant Battery: addressed to Michael Faraday, Esq., D.C.L., F.R.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain. By John Frederic Daniell, Esq., F.R.S., Professor of Chemistry in King's College, London," was resumed and concluded.

The author, pursuing the train of reasoning detailed in his preceding letters, enters into the further investigation of the variable conditions in a voltaic combination on which its efficiency depends; and the determination of the proper proportions of its elements for the economical application of its power to useful purposes. He finds that the action of the battery is by no means proportioned to the surfaces of the conducting hemispheres, but approximates to the simple ratio of their diameters; and hence concludes that the circulating force of both simple and compound voltaic circuits increases with the surface of the conducting plates surrounding the active centres. On these principles he constructed a constant battery consisting of seventy cells in a single series, which gave, between charcoal points separated to a distance of three-quarters of an inch, a flame of considerable volume, forming a continuous arch, and emitting radiant heat and light of the greatest intensity. The latter, indeed, proved highly injurious to the eyes of the spectators, in which, although they were protected by grey glasses of double thickness, a state of very active inflammation was induced. The whole of the face of the author became scorched and inflamed, as if it had been exposed for many hours to a bright midsummer's sun.

The rays, when reflected from an imperfect parabolic metallic mirror in a lantern, and collected into a focus by a glass lens, readily burned a hole in a paper at a distance of many feet from their source. The heat was quite intolerable to the hand held near the lantern. Paper steeped in nitrate of silver and afterwards dried, was speedily turned brown by this light: and when a piece of fine wire-gauze was held before it, the pattern of the latter appeared in white lines, corresponding to the parts which it protected. The phenomenon of the transfer of the charcoal from one electrode to the other, first observed by Dr. Hare, was abundantly apparent; taking place from the *zincode* (or positive pole,) to the *platinode*, (or negative pole). The arch of flame between the electrodes was attracted or repelled by the poles of a magnet, according as the one or the other pole was held above or below it: and the repulsion was at times so great as to extinguish the flame. When the flame was drawn from the pole of the magnet itself, included in the circuit, it rotated in a beautiful manner.

The heating power of this battery was so great as to fuse, with the utmost readiness, a bar of platinum, one-eighth of an inch square: and the most infusible metals, such as pure rhodium, iridium, titanium, the native alloy of iridium and osmium, and the native ore of platinum, placed in a cavity scooped out of hard carbon, freely melted in considerable quantities.

In conclusion, the author briefly describes the results of some experiments on the evolution of the mixed gases from water in a confined space, and consequently under high pressure; with a view to ascertain, first, in what manner conduction would be carried on, supposing that the tube in which the electrodes were introduced were quite filled with the electrolyte, and there were no space for the accumulation of the gases; secondly, whether, decomposition having been effected, recombination would take place at any given pressure; and lastly, whether any reaction on the current-force of the battery would arise from the additional mechanical force which it would have to overcome. These experiments he purposes pursuing at some future time.

A paper was also read, entitled, "An experimental inquiry into the influence of nitrogen in promoting vegetable decomposition, and the connexion of this process with the growth of plants." By Robert Rigg, Esq. Communicated by the Rev. J. B. Reade, A.M., F.R.S.

The author considers it as a general fact, to which there are very few if any exceptions, that vegetable bodies in the state in which they are produced in nature, undergo spontaneous decomposition when kept under circumstances favouring such an action; and that, from the decomposition of each, compound products peculiar to that substance result. A variety of experiments are detailed and tabulated; the first series of which contains those made on solutions of compounds, such as sugar, honey and extract of malt, showing that in each the amount of spontaneous decomposition is in proportion

to the quantity of nitrogen it contains. This law is found to extend to those parts of plants which are not in solution in water, but which remain in their natural state of elaboration, only having their texture broken down.

The author is led to infer from his experiments that the chemical action to which any vegetable matter is naturally disposed, may, to a certain extent, be changed into some other, differing both in its kind and in its products; and that in order to effect such a change nothing more is required than to excite in other vegetable matter mixed with the former, some action which shall preponderate over the rest, so that the whole mass may obey this new and predominant influence. The vapour which is disengaged during the rapid decomposition of vegetable matter he finds to be highly noxious; and thence draws the inference that the Author of the universe has wisely ordained, that, when young plants, containing large quantities of nitrogen, are by any means checked in their growth, they shall be consumed by certain insects; which insects may be conceived to form one of the links of that harmonious chain which binds together all the parts of the universe.

The relation between the decomposition of vegetable matter and the growth of plants is apparent from the similarity of the influence of nitrogen on both these processes: this double function which nitrogen performs in favouring chemical decomposition by the roots of plants at the same time that it assimilates the matter thus formed in their other parts, is regarded by the author as another link in the same chain. In support of this view, he adduces the different chemical constitutions of the roots of the same plants when very young, and when fully grown. He finds that when plants have to perform the important offices of providing nourishment for the rapid growth of their young and tender shoots, they contain a quantity of nitrogen two or three times greater than that which they possess when fully grown; and he concludes by showing that, in accordance with these views, the seeds, roots and plants when placed in highly decomposing or decomposed matter, cease to grow, and under these circumstances, their germinating or vegetating power being superseded by the chemical action established in the matter which surrounds them, the whole becomes one mass of contaminated and infectious matter.

June 6, 1839.

FRANCIS BAILY, Esq., Vice-President, in the Chair.

George Barker, Esq., was balloted for, and duly elected into the Society.

A paper was read, entitled, "Experiments on the chemical constitution of several bodies which undergo the vinous fermentation, and on certain results of the chemical action." By Robert Rigg, Esq., F.R.S.

The special object of this paper is to show, first, that sugar is not constituted of carbon and water only; secondly, that during the vinous fermentation water is decomposed; thirdly, that neither pure carbonic acid nor alcohol is, in the common acceptation of the term, the product of this chemical action; and fourthly, that fermented liquors owe some of their valuable qualities to peculiar products formed during fermentation.

In order to trace the various chemical changes which occur in this part of his research, the author has had recourse to numerous experiments, the details of which are recorded in tabular forms. The first table exhibits the analysis of different kinds of sugar, honey, treacle, grape-juice and extract of malt and hops, the general result of which is that all these compounds contain oxygen in excess above the proportion in which it exists in water, and that they also contain a small quantity of nitrogen. He shows, by two independent modes of experimenting, that these bodies, when in solution, cannot be the only compounds undergoing decomposition during that fermentation, which has for its product spirit and carbonic acid; and in proof of this proposition he recapitulates the different elements in the compounds at the commencement and at the conclusion of the experiments. He finds that when the proximate elements are made the subject of calculation, the weight of the alcohol (constituted of two equivalents of carbon, three of hydrogen and one of oxygen) added to that of the carbonic acid and undecomposed sugar, exceeds the weight of the sugar employed by about 7 per cent. On recapitulating the ultimate elements, he finds that the hydrogen and the oxygen in the compounds after the fermentation exceed their quantity in the sugar experimented upon, by 15 per cent. of the former, and nearly 14 per cent. of the latter; and as a proof that no material error is occasioned by the mode of experimenting, it is found that the difference between the quantity of carbon at the first and at the last is very small.

Having arrived at these conclusions, the author infers from his experiments that the water of solution is decomposed by the carbon of the dissolved vegetable matter, in every case of the vinous fermentation, and in proportions proximately represented by the following formulæ: viz.

2 equivalents of the carbon of sugar	6·12	12·24	14·24 olefiant gas.
2 equivalents of the hydrogen of the water	1·	2·	
1 equivalent of the carbon of the sugar...	6·12	6·12	22·12 carbonic acid.
2 equivalents of the oxygen of the water...	8·	16·	

This decomposition he conceives is brought about by the influence of nitrogen, a very small quantity of which enters into the constitution of the olefiant gas, forming the base of all spirituous fluids of the alcohol and ethereal kind; and thus each compound experimented upon, forms these products in proportion to the quantity of carbon which undergoes chemical change, whether that compound be sugar, soluble parts of malt, grape-juice, or any other body.

The author proceeds to inquire into the constitution of the pro-

ducts which result from this chemical action. He finds the gas which is given off to be composed of carbonic acid, mixed with a small proportion of carburetted hydrogen; and the spirit, when subjected to careful analysis, to resolve itself into carbonic acid, water, and a very small proportion of nitrogen: and in further proof of the existence of this last-mentioned element in spirit, the author has recourse to the ultimate analysis of the charcoal obtained from alcohol and olefiant gas, a mode of experimenting which he conceives is less liable to error.

He states that the views thus sought to be established are confirmed, not merely by these direct experiments, but likewise by other changes which fermented liquors undergo on being kept under circumstances favourable for further chemical action; and that having proved the existence of such a compound as one constituted of carbon, hydrogen and nitrogen, and shown that water is decomposed during its formation, he thinks we are enabled to account for many other changes which occur during the decomposition of vegetable matter and the growth of plants: whence he proceeds to show that evidence of the presence of such a compound as the above in fermented liquors is afforded by the changes which take place in consequence of keeping them.

On subjecting to ultimate analysis the semi-fluids obtained by exposing fermented liquors to a temperature of 110° Fahr., the author found a decided difference between the chemical constitution of those procured from old, and those from new vinous fluids; and on searching for the law by which these differences are regulated, he found that the spirituous part entered into such combination with the excess of oxygen before referred to, and the undecomposed vegetable matter, so as to form with them new compounds.

After experiencing some difficulty in effecting a separation of these newly formed bodies, he found that while rectified pyroxylic spirit, of the specific gravity from 830 to 835, scarcely dissolved an appreciable quantity of the extract of malt and hops, considerable portions of the semi-fluids obtained from old ale and old porter were, by agitating, dissolved therein. By using this spirit as a solvent he effected such a separation as enabled him to discover decided differences between the proximate chemical constitution of the semi-fluids obtained from old ale and old porter, and those from liquors of the same description when new.

In accounting for many of the phenomena which accompany the vinous fermentation, the author observes that the small excess of oxygen found in all these compounds, which undergo this chemical action, is an essential and indispensable circumstance; a conclusion which is corroborated both by the formation of these new compounds which have been described, and by the generation of the acetic, tartaric, or malic acid, which is found in fermented liquors at all times, and in quantities varying according to the situations under which these fluids have been kept.

June 13, 1839.

JOHN W. LUBBOCK, Esq., V.P. and Treas., in the Chair.

The ballot for Edwin Guest, Esq., was postponed in consequence of the number of Fellows required by the Charter not being present.

The following papers were read, viz.:—

"Researches on the Tides. Tenth Series. On the Laws of Low Water at the Port of Plymouth, and on the permanency of mean water." By the Rev. W. Whewell, B.D., F.R.S., Fellow of Trinity College, Cambridge.

In this memoir the author investigates the question, how far the *mean water*, that is the height of the tide midway between high and low water, is permanent during the changes which high and low water undergo. That it is so approximately at Plymouth having been already ascertained by short series of observations, it was desirable to determine the real amount of this permanency by induction from longer series of observations. A period of six years was chosen for that purpose; and the method of discussing these observations was the same, with slight modifications, as in former researches.

The height of low water, cleared from the effects of lunar parallax, and very nearly so from those of lunar declination, and compared with the height of high water, similarly cleared, enabled the author to ascertain whether the mean water also was affected by the semi-menstrual inequality. The results of the calculation show that the height of mean water is, within two or three inches, constant from year to year: and that, for each fortnight, it has a semi-menstrual inequality amounting to six or seven inches;—the height being greatest when the transit is at 6h. and least when at 11 h.,—the immediate cause of this inequality being, that the semi-menstrual inequality of low water is greater than that of high water: this inequality, however, is probably modified by local circumstances.

These researches have also verified the theoretical deduction, that the height both of low and of high water being affected by the moon's declination, their mean height partakes of the variations in this latter element, in successive years, consequent on the change of position of the moon's orbit. At Plymouth the increase in mean low water amounts to about two inches for each degree of increase in the declination. In the high water this change is less marked.

The parallax correction of the height of low water is obtained from all years alike, by taking the residue of each observation, which remains when the semi-menstrual inequality is taken away, and arranging these residues, for each hour of transit, according to the parallax. The declination correction is obtained in a manner analogous to the parallax correction, from each year's observations, with some correction for the variation in the mean declination of the moon in each year.

"Researches on the Tides. Eleventh Series. On certain Tide

Observations made in the Indian Seas." By the Rev. W. Whewell, B.D., F.R.S., Fellow of Trinity College, Cambridge.

This paper contains the results of the examination by the author of certain series of tide observations made at several places in the Indian Seas, which were forwarded to the Admiralty by the Hon. East India Company. These localities were Cochin, Corringa River, Surat roads in the Gulf of Cambay, Gogah, on the opposite side of the same gulf, and Bassadore, in the Island of Kissmis in the Persian Gulf.

"On the Electrolysis of Secondary Compounds." In a letter addressed to Michael Faraday, Esq., D.C.L., F.R.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain, &c., &c. By John Frederic Daniell, Esq., F.R.S., Professor of Chemistry in King's College, London.

The discovery of definite electrochemical action naturally suggests the inquiry into the relative proportion of that part of a voltaic current, which, in the case of its decomposing a saline solution, is carried by the elements of the water, and that part which is carried by the elements of the saline compound, and into the definite relations, if any such there be, subsisting between the two electrolytes so decomposed. This question was the origin of the investigation which forms the subject of the present letter. The power which the author employed in this experimental inquiry was that of a small constant battery of thirty cells, six inches in height, with tubes of earthenware, charged in the manner he has described in his former communications to the Society. The result of the first experiment evidently indicated that the decomposition of one equivalent of water was accompanied by the decomposition of an exact equivalent of sulphate of soda. The author then endeavours to ascertain whether the power of the current is equally divided between what had hitherto been regarded as the two equivalent electrolytes. The first experiments he made in order to determine this point seemed to lead to the extraordinary conclusion, that the same current which is just sufficient to separate an equivalent of oxygen from an equivalent of hydrogen in one vessel, will at the same time separate an equivalent of oxygen from one of hydrogen, and also an equivalent of sulphuric acid from one of soda in another vessel.

The author then examines the remarkable phenomena relative to the transfer of matter from one electrode to the other without the decomposition of the transported compound; a phenomenon which was first observed by Mr. Porret in glass cells divided into two compartments by a diaphragm of bladder.

Having observed that the products of electrolyzation cannot be kept long separate in their respective cells, on account of the ultimate mixture of the liquids on the platinode side of the diaphragm, the author was led to construct an apparatus by which this evil is remedied much more perfectly, and to which he gives the name of *the double diaphragm cell.* It consists of two cells, formed of two glass cylinders, with collars at their lower ends, fitted by grinding

to a stout glass tube bent into the form of the letter U, and firmly fixed on a wooden post. The current transmitted by this double cell is more retarded than when passing through the single cell, on account of the greater distance of the electrodes; but it answers its intended purpose of stopping the transfer of the liquid even in the case of saline solutions, and there is still sufficient conducting power to render it powerfully effective. Experiments were then made to ascertain whether in the electrolysis of the dilute sulphuric acid any transfer of the acid takes place; from which the author concludes that during the electrolysis of an equivalent of water, a portion of acid passes over from the platinode to the zincode; and possibly an equal portion of water also passes over from the zincode to the platinode. These experiments appear to confirm the results previously obtained; namely, that one fourth of an equivalent of sulphuric acid passes from the platinode to the zincode for every single equivalent of a compound which has been electrolyzed by the current.

The author then proceeds to examine the following question, viz.: does the acid during its transfer, in the case of the mixed acid and water, or do the acid and the alkali, in the case of the saline solution, convey any portion of the current which effects the simultaneous decomposition of the water in both instances? He next investigates the action of the voltaic current on the aqueous solution of the chlorides, as the simpler constitution of this class of salts promised to throw some light on the nature of the electrolysis of secondary compounds.

The results of all these experiments tend to the establishment of the fundamental principle, that the force which is measured by its definite action at any one point of a circuit cannot perform more than an equivalent proportion of work at any other point of the same circuit; and that the current, which is measured by its electrolysis of an equivalent of simple chloride of lead, cannot at the same time be sufficient to electrolyze an equivalent of chloride of sodium, and an equivalent of water, at the same electrodes. The sum of the forces which held together any number of *ions*, in a compound electrolyte, could, moreover, only have been equal to the force which held together the elements of a simple electrolyte, electrolyzed at the same moment in one circuit.

In applying these principles to the electrolysis of the solution of sulphate of soda, water seems to be electrolyzed, and at the same time the acid and alkali of the salt appear in equivalent proportions with the oxygen and hydrogen, at their respective electrodes. It cannot be admitted, that after the decomposition of the water there is any excess of force applicable to the decomposition of the salt; but it must be concluded that the only electrolyte which yields is the sulphate of soda, the *ions* of which, however, are not the acid and alkali of the salt, but an *anion*, composed of an equivalent of sulphur, and four equivalents of oxygen and the metallic *cathion*, sodium. From the former, sulphuric acid is formed, at the *anode*, by secondary action, and the evolution of one equivalent of oxygen; and from the latter, soda at the cathode, by the secondary action of

the metal, and the evolution of an equivalent of hydrogen. The formation of these secondary electrolytes, and compound anions and cathions, will probably furnish the key to the explanation of many of those decompositions and recompositions, to which the presence of water is necessary, such as those of nitric acid on the metals, and the formation of Schœnbein's circuit: but the author reserves for a future opportunity the examination of this hypothesis, as well as of the general question.

"Experimental Researches on the mode of operation of Poisons." By James Blake, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

In this paper the author examines more particularly the action of those poisons which appear to produce death by affecting the nervous system.

After reviewing the evidence adduced in support of the opinion, that the effects of some poisons are owing to an impression made on the nerves of the part to which they are directly applied, he proceeds to relate a series of experiments undertaken in order to show with what rapidity the blood is circulated through the body, and tending to prove, that a substance may be generally diffused through the system in nine seconds after its introduction into the veins.

Experiments are then related in which the more rapidly fatal poisons had been used, and in which it was found, that an interval of more than nine seconds always elapsed, between the administration of a poison, and the appearance of the first symptoms of its action. The mere contact of a poison with a large surface of the body appears to be insufficient to give rise to general effects, as long as it is prevented from entering into the general circulation.

Various causes of fallacy in experiments of a similar kind, which have been adduced in support of an opposite opinion, are pointed out. The following is a summary of the conclusions arrived at by the author.

1. The time required for a substance to penetrate the capillary vessels, may be considered as inappreciable.

2. The interval elapsing between the absorption of a substance by the capillaries, and its general diffusion through the body, may not exceed nine seconds.

3. An interval of more than nine seconds always elapses between the introduction of a poison, into the capillaries, or veins, and the appearance of its first effects.

4. If a poison be introduced into a part of the vascular system nearer the nervous centres, its effects are produced more rapidly.

5. The contact of a poison with a large surface of the body is not sufficient to give rise to general symptoms, as long as its diffusion through the body is prevented.

June 20, 1839.

JOHN W. LUBBOCK, Esq., V.P. and Treas., in the Chair.

Sir Thomas Dyke Acland, Bart., M.P., Edwin Guest, Esq., and John Hogg, Esq., M.A., were balloted for and severally elected into the Society.

The following papers were read: viz.

1. " Inquiries concerning the Elementary Laws of Eléctricity." Third Series. By W. Snow Harris, Esq., F.R.S.

The author states, that it has been his object, in this series of investigations, to perfect the methods of electrical measurement, whether relating to the quantity of electricity, intensity, inductive power, or any other element requiring an exact numerical value, and by operating with large statical forces both attractive and repulsive, to avoid many sources of error inseparable from the employment of extremely small quantities of electricity, such as those affecting the delicate balance used by Coulomb. He then describes some improvements in his hydrostatic electrometer, an instrument already mentioned in his first paper, which, although not available for the measurement of such minute forces as those to which the balance of torsion is applicable, is still peculiarly delicate and well adapted to researches in statical electricity. Its indications depending on the force between two opposed planes operating on each other under given conditions, are reducible to simple laws, and are hence invariable and certain; the attractive force between the discs is not subject to any oblique action, is referable to any given distance, and may be estimated in terms of a known standard of weight. The author next proceeds to the further consideration of the subject of his former papers, viz. the elementary laws of electrical action. He proves, by the following experiments, that induction invariably precedes, or at least accompanies attraction and repulsion.

A circular disc of gilded wood, about six inches in diameter, is suspended by an insulating thread of varnished silk from a delicate balance; a delicate electroscope is attached to this disc, and the whole is counterpoised by a weight. A similar disc insulated on a glass rod, and having also an electroscope attached to it, is placed at any convenient distance immediately under the former. One of the lower discs being charged with either electricity and the other remaining insulated and neutral, the electroscope of the neutral disc begins to rise, whilst that of the charged disc, already in a state of divergence, tends to collapse: when these respective effects ensue, the suspended disc descends the charged disc. Two inductive actions are indicated in this experiment, the one the author considers to be a direct induction, the other a reflected induction.

If the two discs are both charged with opposite electricities, on opposing them as before, the electroscopes begin to fall back, at

which moment the discs appear to attract each other. But if the discs are both charged with the same kind of electricity, the divergence of the electroscopes increases, and at this instant the suspended disc recedes from that which is fixed, being apparently repelled by it.

The author proceeds to examine strictly the nature of this inductive influence, and adduces experiments to render probable that it is in some way dependent on the presence of an exquisitely subtile form of matter which may become disturbed in bodies, and assumes new states or conditions of distribution.

Very numerous experiments are detailed, showing the influence of changes of different intensity, of changes in the dimensions and distances of the opposed discs, of interposed bodies of different forms, &c. on the phenomena of induction. The author concludes by giving the following formulæ as the results of his investigations regarding the elementary laws of electrical induction and attraction. In these expressions $Q =$ quantity of charge, $T =$ the direct induction, $q =$ the quantity of electricity displaced, $t =$ its intensity, $T' =$ the reflected induction, $q' =$ the disturbed quantity, $t' =$ its intensity, $q'' =$ the total quantity in the opposed charged surface, $A =$ the surface, $D =$ the distance between the opposed points, $F =$ the force of attraction.

For the direct induction:

$$T = \frac{Q}{\sqrt{D}} \qquad t = \frac{Q^2}{D}.$$

For the reflected induction:

$$T' = q' = \frac{Q}{D} \qquad t' = \frac{Q^2}{D^2} \qquad q'' = \frac{Q}{\sqrt{D}}.$$

For the attractive force between a charged and a neutral free conductor:

$$F = \frac{Q^2}{D^2} \qquad F = \frac{T}{A^2}.$$

For the force between two unchangeable surfaces, one positive the other negative:

$$F = \frac{Q^2}{D}.$$

2. "On the Conditions of Equilibrium of an Incompressible Fluid, the particles of which are acted upon by Accelerating Forces." By James Ivory, Esq., K.H., M.A., F.R.S., &c.

The intention of this paper is to examine the principles and methods that have been proposed for solving the problem of which it treats, with the view of obviating what is obscure and exceptionable in the investigation usually given of it.

The principle first advanced by Huyghens is clearly demonstrated, and is attended with no difficulty. This principle requires that the resultant of the forces in action at the surface of a fluid in equili-

brium and at liberty, shall be perpendicular to that surface: and it is grounded on this, that the forces must have no tendency to move a particle in any direction upon the surface, that is, in a plane touching the surface.

In the Principia, Sir Isaac Newton assumes that the earth, supposed a homogeneous mass of fluid in equilibrium, has the figure of an oblate elliptical spheroid of revolution which turns upon the less axis: and, in order to deduce the oblateness of the spheroid from the relation between the attractive force of the particles, and their centrifugal force caused by the rotatory velocity, he lays down this principle of equilibrium, that the weights or efforts of all the small columns extending from the centre to the surface, balance one another round the centre. The exactness of this principle is evident in the case of the elliptical spheroid, from the symmetry of its figure: and it is not difficult to infer that the same principle is equally true in every mass of fluid at liberty and in equilibrium by the action of accelerating forces on its particles. In every such mass of fluid, the pressure, which is zero at the surface, increases in descending below the surface on all sides: from which it follows that there must be a point in the interior at which the pressure is a maximum. Now this point of maximum pressure, or centre, is impelled equally in all directions by all the small columns standing upon it and reaching to the surface; and as the pressure in every one of these columns increases continually from the surface to the centre, it follows that the central point sustains the total effect of all the forces which urge the whole body of fluid. It follows also, from the property of a maximum, that the central point may be moved a little from its place without any variation of the pressure upon it: which proves that the forces at that point are zero. Thus the point of maximum pressure is in stable equilibrium relatively to the action of the whole mass of fluid: which establishes Newton's principle of the equiponderance of the central columns in every instance of a fluid in equilibrium and at liberty.

The two principles of Huyghens and Newton being established on sure grounds, the next inquiry is, whether they are alone sufficient for determining the figure of equilibrium. Of this point there is no direct and satisfactory investigation: and, in applying the two principles to particular cases, it has been found that an equilibrium determined by one, is not in all cases verified by the other; and even in some instances, that there is no equilibrium when both principles concur in assigning the same figure to the fluid. Further researches are therefore necessary to dispel the obscurity still inherent in this subject.

In a mass of fluid in equilibrium, if we suppose that small canals are extended from a particle to the surface of the mass, the particle will be impelled with equal intensity by all the canals: for, otherwise, it would not remain immoveable, as an equilibrium requires. It has been inferred that the equal pressures of the surrounding fluid upon a particle are sufficient to reduce it to a state of rest. Hence has arisen the principle of equality of pressure, which is generally

admitted in this theory. Now, if the matter be considered accurately, it will be found that the only point within a mass of fluid in equilibrium which is at rest by the sole action of the surrounding fluid, is the central point of Newton, or the point of maximum-pressure. The reason is that, on account of the maximum, the pressure of all the canals terminating in the central point, increases continually as the depth increases; so that, besides the pressures of the canals, there is no other cause tending to move the particle. With respect to any other particle, the pressure caused by the action of the forces in some of the canals standing upon the particle, will necessarily increase at first in descending below the surface, and afterwards decrease; so that the effective pressure transmitted to the particle, is produced by the action of the forces upon a part only of the fluid contained in such canals. If a level surface be drawn through any particle, it is proved in the paper, that the equal pressures of the surrounding fluid on the particle, are caused solely by the forces which urge the portion of the fluid on the outside of the level surface, the fluid within the surface contributing nothing to the same effect. Thus a particle in a level surface is immoveable by the direct and transmitted action of the fluid on the outside of the level surface; but it will still be liable to be moved from its place unless the body of fluid within the level surface have no tendency to change its form or position by all the forces that act on its own particles.

What has been said not only demonstrates the insufficiency of the principle of equality of pressure for determining the figure of equilibrium of a fluid at liberty, but it points out the conditions which are necessary and sufficient for solving the problem in all cases. The pressure must be a maximum at a central point within the mass: it must be zero at the surface of the fluid: and, these two conditions being fulfilled, there will necessarily exist a series of interior level surfaces, the pressure being the same at all the points of every surface, and varying gradually from the maximum quantity to zero. Now all the particles in the same level surface have no tendency to move upon that surface, because the pressure is the same in all directions: wherefore if we add the condition that every level surface shall have a determinate figure when one of its points is given, it is evident, both that the figure of the mass will be ascertained, and that the immobility of the particles will be established.

Maclaurin's demonstration of the equilibrium of the elliptical spheroid will always be admired, and must be instructive from the accuracy and elegance of the investigation. That geometer was the first who discovered the law of the forces in action at every point of the spheroid; and it only remained to deduce from the known forces the properties on which the equilibrium depends. These properties he states as three in number; and of these, the two which relate to the action of the forces at the surface and the centre of the spheroid, are the same with the principles of Huyghens and Newton, and coincide with two of the conditions laid down above. The third property of equilibrium, according to Maclaurin, consists in this, that every particle is impelled equally by all the rectilineal canals stand-

ing upon it and extending to the surface of the spheroid. Now it does not follow from this property that a particle is reduced to a state of rest within the spheroid, by the equal pressures upon it of the surrounding fluid: because these pressures may not be the effect of all the forces that urge the mass of the spheroid, but may be caused by the action of a part only of the mass. Maclaurin demonstrates that the pressure impelling a particle in any direction is equivalent to the effort of the fluid in a canal, the length of which is the difference of the polar semi-axes of the surface of the spheroid and a similar and concentric surface drawn through the particle, which evidently implies both that the pressures upon the particle are caused by the action of the fluid between the two surfaces, and likewise that the pressures are invariably the same upon all the particles in any interior surface, similar and concentric to the surface of the spheroid. Such surfaces are therefore the level surfaces of the spheroid; and every particle of the fluid is at rest, not because it is pressed equally in all directions, but because it is placed on a determinate curve surface, and has no tendency to move on that surface on account of the equal pressures of all the particles in contact with it on the same surface. Maclaurin seems ultimately to have taken the same view of the matter, when he says that* "the surfaces similar and concentric to the surface of the spheroid, are the level surfaces at all depths." It thus appears that the conditions laid down above as necessary and sufficient for an equilibrium, agree exactly with the demonstration of Maclaurin, when the true import of what is proved by that geometer is correctly understood.

The general conditions for the equilibrium of a fluid at liberty being explained, the attention is next directed to another property, which is important, as it furnishes an equation that must be verified by every level surface. If we take any two points in a fluid at rest, and open a communication between them by a narrow canal, it is obvious that, whatever be the figure of the canal, the effort of the fluid contained in it will be invariably the same, and equal to the difference of the pressures at the two orifices. As the pressure in a fluid in equilibrium by the action of accelerating forces, varies from one point to another, it can be represented mathematically only by a function of three co-ordinates that determine the position of a point: but this function must be such as is consistent with the property that obtains in every fluid at rest. If a, b, c, and a', b', c', denote the co-ordinates of the two orifices of a canal; and $\phi\ (a, b, c)$ and $\phi\ (a', b', c')$ represent the pressures at the same points; the function $\phi\ (a, b, c)$ must have such a form as will be changed into $\phi\ (a', b', c')$, through whatever variations the figure of a canal requires that a, b, c must pass to be finally equal to a', b', c'. From this it is easy to prove that the co-ordinates in the expression of the pressure must be unrelated and independent quantities. The forces in action are deducible from the pressure; for the forces produce the variations of the pressure. As the function that stands for the press-

* Fluxions, § 640.

ure is restricted, so the expressions of the forces must be functions that fulfil the conditions of integrability, without which limitation an equilibrium of the fluid is impossible. Thus, when the forces are given, the pressure may be found by an integration, which is always possible when an equilibrium is possible: and as the pressure is constant at all the points of the same level surface, an equation is hence obtained that must be verified by every level surface, the upper surface of the mass being included. But although one equation applicable to all the level surfaces may be found in every case in which an equilibrium is possible, yet that equation alone is not sufficient to give a determinate form to these surfaces, except in one very simple supposition respecting the forces in action. When the forces that urge the particles of the fluid, are derived from independent sources, the figure of the level surfaces requires for its determination as many independent equations as there are different forces.

In the latter part of the paper the principles that have been laid down are illustrated by some problems. In the first problem, which is the simplest case that can be proposed, the forces are supposed to be such functions as are independent of the figure of the fluid, and are completely ascertained when three co-ordinates of a point are given. On these suppositions all the level surfaces are determined, and the problem is solved, by the equation which expresses the equality of pressure at all the points of the same level surface.

As a particular example of the first problem, the figure of equilibrium of a homogeneous fluid is determined on the supposition that it revolves about an axis and that its particles attract one another proportionally to their distance. This example is deserving of attention on its own account; but it is chiefly remarkable, because it would seem at first, from the mutual attraction of the particles, that peculiar artifices of investigation were required to solve it. But in the proposed law of attraction, the mutual action of the particles upon one another is reducible to an attractive force tending to the centre of gravity of the mass of fluid, and proportional to the distance from that centre: which brings the forces under the conditions of the first problem.

The second problem investigates the equilibrium of a homogeneous planet in a fluid state, the mass revolving about an axis, and the particles attracting in the inverse proportion of the square of the distance. The equations for the figure of equilibrium are two; one deduced from the equal pressure at all the points of the same level surface; and the other expressing that the stratum of matter between a level surface and the upper surface of the mass, attracts every particle in the level surface in a direction perpendicular to that surface. No point can be proved in a more satisfactory manner than that the second equation is contained in the hypothesis of the problem, and that it is an indispensable condition of the equilibrium. Yet, in all the analytical investigations of this problem, the second equation is neglected, or disappears in the processes used for simplifying the calculation and making it more manageable: which is a remarkable

instance of attempting to solve a problem, one of the necessary conditions being omitted.

The equations found in the second problem, are solved in the third problem, proving that the figure of equilibrium is an ellipsoid.

3. "Report of a Geometrical Measurement of the Height of the Aurora Borealis above the Earth." By the Rev. James Farquharson, LL.D., F.R.S.

The principal object to which the author directed the inquiries of which he here gives an account, is the determination by geometrical measurement of the height of the aurora borealis, and of the altitude and azimuth of the point to which the streamers seem to converge, and which has been termed the *centre of the corona*: these latter determinations constituting important data for enabling us to form a clear conception of the whole definite arrangement and progress of the meteor, and also a correct judgement of the degree of reliance to be placed on the methods employed for measuring its height above the earth. The paper is chiefly occupied with the details of the observations made or collected by the author, with their critical discussion, with the correction of some misapprehensions which have existed respecting the views stated by the author in his former papers, and with a reply to the strictures of M. Arago on those views.

The result of the geometrical measurement of one particular aurora, gave as the height of its upper edge, 5693 feet above the level of the Manse at Alford; and the vertex of its arch was found to be 14,831 feet northward of the same place. The vertical extension of the fringe of streamers was 3212 feet; leaving 2481 feet for the height of the lower edge above the level of Alford. The tops of the Corean hills, immediately under the aurora, are about 1000 feet higher than that level; so that the lower edge of the arch was only 1500 feet above the summit of that range of hills.

4. "On the Phosphates." By John Dalton, D.C.L., F.R.S., &c.

The author takes a review of the labours of preceding chemists which bear upon the subject of the atomic constitution of phosphoric acid, and the salts in which it enters as a constituent; and shows their conformity with the views he has already advanced on the subject. A supplement is added, giving an account of the effects of various degrees of heat on the salt denominated the *pyrophosphate of soda.*

5. "On the Arseniates." By the Same.

The author here examines the conformity of the results of the analysis of the salts of arsenic with his theory, in the same manner as he has done with the phosphates in the preceding paper.

6. "On the Constitution of the Resins." Parts II. and III. By J. F. W. Johnston, Esq., F.R.S.

In this paper the author, pursuing the train of investigation of

which he has already given an account in a former communication, gives tabulated results of his chemical examination of several varieties of gamboge, and formulæ expressing their chemical constitution. A detailed account is given of the properties of the gambodic acid, and of the salts it forms with various bases, such as the gambodiates of potash and soda, of ammonia, and of different earths and metals, particularly lime, strontia, magnesia, lead, copper, zinc, and silver. He concludes from this investigation that the most probable formula for gamboge is $C_{40}\ H_{23}\ O_8$. In the analysis, however, of every specimen, there occurred a deficiency of carbon, amounting to nearly one per cent.; a deficiency supposed to be due to a change produced during the preparation of the natural resin for the market. By a heat of 400° Fahr. gamboge undergoes a partial decomposition; a resin, soluble in alcohol, and another resin, insoluble in that menstruum being formed: the formula representing the latter being $C_{40}\ H_{22}\ O_9$. Gamboge forms with the metallic oxides numerous salts, the existence and constitution of which, however, the experiments of the author only render probable.

The inquiries of the author were next directed to the chemical constitution of the resin of guaiacum, and to the properties of the salts it forms with various bases. He then examines the *acaroid resin*, which exudes from the *Xanthorrhœa hastilis*, and is often known by the name of *Botany-bay resin*, or *yellow gum*; and finds its formula to be $C_{40}\ H_{20}\ O_{12}$, showing that it contains more oxygen than any other resinous substance hitherto analyzed.

The general conclusions drawn by the author from these researches are the following.

1. Many of the resins may be represented by formulæ exhibiting their elementary constitution, and the weight of their equivalents, in which 40 C is a constant quantity.

2. There appear to be groups, in which the equivalents, both of carbon and the hydrogen, are constant, the oxygen only varying; and others, in which the hydrogen alone varies, the two other elements being constant.

In the third part of the same series of investigations, the author examines the constitution of the resin of Sandarach of commerce, which he finds to consist of three different kinds of resin, all of which possess acid properties. In like manner he finds that the resin of the *Pinus abies*, or spruce fir, commonly called *Thus*, or ordinary *Frankincense*, consists of two acid resins; the one easily soluble in alcohol, the other sparingly soluble in that menstruum. The gum resin *olibanum*, of commerce, was found to consist of a mixture of at least two gum resins, the resinous ingredient of each of which differs from that of the other in composition and properties.

7. " On the Markings of the Eel-back Dun variety of the Horse, common in Scotland;" in a letter to P. M. Roget, M.D., Sec. R.S. By W. Macdonald, M.D., Fellow of the Royal College of Physicians of Edinburgh, F.R.S. Ed., F.L.S., &c. Communicated by Dr. Roget.

The author states some observations which he has made on the coloured marks apparent in a variety of the horse, common in Scotland, and there called the *Eel-back Dun*, and which afford grounds for doubting the accuracy of the conclusions deduced in a paper, by the late Earl of Morton, published in the Philosophical Transactions for 1820. The title of the paper referred to is "A Communication of a singular fact in Natural History," namely, that a young chestnut mare of seven-eighths Arabian blood, after producing a female hybrid by a male quagga, had subsequently produced, by a fine black Arabian horse, a filly and a colt, both of which had the character of the Arabian breed as decidedly as could be expected where fifteen-sixteenths of the blood are Arabian, but in colour, in the hair of their manes, and the markings of the back and legs, bore a striking resemblance to the quagga.

The author, finding that similar markings are very commonly met with on the Eel-back dun ponies of Scotland, suggests, that as the breed of the mare in question was not pure she may have inherited the tendency to those peculiar markings. He moreover observes, that the cross bar markings on the legs are not found in the *quagga*, but only in the *zebra*, which is a species quite distinct from the quagga; a fact which he considers as completely overturning the reasoning by which the conclusions stated in Lord Morton's paper were deduced. The facts, he thinks, admit of a more natural explanation, and one more consistent with the known physiological laws of developement, by supposing the stain in the purity of the mare's Arab blood to have arisen from the circumstance of an early progenitor of the mare having belonged to the Eel-backed dun variety, the peculiarities of which reappeared in a later generation.

8. "On the Structure and Functions of the Spleen." By Thomas Gordon Hake, M.D. Communicated by Francis Kiernan, Esq., F.R.S.

The author, passing in review the various opinions which have been advanced by anatomists respecting the intimate structure of the spleen, arrives at the conclusion that hitherto only vague and premature inductions have been made. It is generally admitted that the fibrous envelope of this organ is formed of the external fibres of the splenic vein; and that from the internal surface of this envelope fibrous prolongations are continued into the interior of its substance, giving support to a fine cellular membrane, which is continuous with their edges, and variously reflected so as to constitute cells. The parenchyma, or solid structure of the spleen, everywhere accompanies these membranous productions, and forms the exterior walls of the cells; being composed of branches of the splenic arteries, of the granular terminations of those arteries constituting the *splenic grains* of Malpighi, of *venules*, which ramify around the splenic grains, and of *cellules*, into which the venules open, and from which the splenic veins take their rise. The author concludes, as the result of his inquiries, that a dilatable cellular tissue exists, containing venous blood, between the granules within which the arteries ter-

minate, and the venules on the outer side of the splenic grains: that the venous membrane, which is continued from the cells to the cellules, as well as to the venules, becoming more and more attenuated, but without changing its essential structure, gradually loses its tubular form, and resumes its primitive character of cellular tissue; and that the artèry, in like manner, is limited in its distribution within the granules by a cellular structure, which becomes vicarious of it, and determines the function it has to perform.

The author, in conclusion, offers some observations on the probable functions of the spleen. He considers the opinion which supposes that organ to be distended, at particular times, with arterial blood, as being completely refuted by the evidence derived from the preceding account of its minute structure; and suggests the probability of the spleen being rather a diverticulum for venous blood.

The paper is accompanied by seven highly finished drawings illustrating the structures described.

9. "Additional Experiments on the formation of Alkaline and Earthy Bodies by chemical action when carbonic acid is present." By Robert Rigg, Esq., F.R.S.

The author gives a detailed account of several experiments in which sugar, water, and yeast only were employed, and from which he deduces the conclusion that alkaline and earthy matters are formed by chemical action. In one set of experiments, some of which were made in silver, others in china, and others in glass apparatus, after the vinous fermentation had gone on during five days, the quantity of ashes obtained was, in the silver apparatus eighteen, in the china nineteen, and in the glass fifteen times greater than the previous quantity. A further examination of these ashes showed that they consisted of potass, soda, lime, and a residue not acted upon by muriatic acid. The author states that, however irreconcilable to our present chemical knowledge this important conclusion may at first sight appear, yet when it is taken in connexion with the decomposition of other vegetable matter, and with the phenomena which accompany the growth of plants, it may not excite surprise; and may be regarded as in harmony with the phenomena of natural science. He concludes by offering suggestions towards extending the inquiry into the subject of the formation of bones of animals by the action of the powers inherent in their organization.

10. "On the Difference of Colour in different parts of the Bodies of Animals." By James Alderson, M.A., M.D., late Fellow of Pembroke College, Cambridge. Communicated by P. M. Roget, M.D., Sec. R.S., &c.

The hypothesis advanced by the author in explanation of the well-known partial absence of the coloured pigment or *rete mucosum*, in different parts of the human body, and that of other animals, is that it is due to the union or adhesion of the epidermis and the true skin, so as to exclude the rete mucosum. He supports this hypothesis by the analogy of a cicatrix, which is the result of an organization of a

certain portion of lymph, poured out from the cut surfaces of a wound, as part of the process of nutrition, or as the consequence of a small amount of inflammation, induced either from mechanical irritation, or other accidental circumstance. This hypothesis was suggested by the colourless appearance of the cicatrix from the section of the umbilical cord in the negro, and also of that seen by the author at the umbilicus of the bottle-nosed whale, the *Hyperoodon bidentatus*.

The Society then adjourned over the long vacation to meet again on the 21st November next.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1839. No. 40.

Nov. 21, 1839.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following gentlemen were, by ballot, elected Auditors of the Treasurer's accounts, on the part of the Society, viz. Thomas Bell, Esq., Bryan Donkin, Esq., Edward Forster, Esq., Major Edward Sabine, R.A., and John Taylor, Esq.

No paper read.

November 30, 1839.

At the Anniversary Meeting,

The MARQUIS of NORTHAMPTON, President, in the Chair,

Mr. Forster, on the part of the Auditors of the Treasurer's Accounts, reported that the total receipts during the last year, inclusive of a balance of £1463 14*s.* 5*d.*, carried from the account of the preceding year, amounted to £4349 11*s.* 4*d.*: that the total payments in the same period amounted to £2541 1*s.* 9*d.*, leaving a balance in the hands of the Treasurer of £1808 9*s.* 7*d.*

The thanks of the meeting were given to the Auditors for the trouble they have taken in examining the Treasurer's accounts.

The Secretary read the following list of deceased Fellows of the Royal Society since the last anniversary in 1838; of those who have ceased to be Fellows in default of their annual payments; and of Fellows admitted into the Royal Society since the last anniversary.

List of deceased Fellows of the Royal Society since the last Anniversary (1838).

On the Home List, viz.

The Rev. Archibald Alison.
William Beetham, Esq.
Robert Bree, M.D.
Edward Coleman, Esq.
The Rev. John Corrie.
The Rev. Martin Davy, D.D.
Richard Gregory, Esq.
Edmund H. Lushington, Esq., M.A.
William Macmichael, M.D.
The Earl of Mount-Edgecumbe, D.C.L.
Whitlock Nicholl, M.D.
The Lord Bishop of Peterborough (*Herbert Marsh*).
Stephen Peter Rigaud, Esq., M.A.
Isaac Robinson, Esq.
Sir William Russell, Bart., M.D.
Sir John St. Aubyn, Bart.
The Rev. Thomas Sampson, D.D.
George Saunders, Esq.
Charles Short, Esq.
John Storer, M.D.

On the Foreign List, viz.

Pierre Prévost, of Geneva.
Le Baron de Prony, of Paris.

Ceased to be Fellows in default of their annual payments, viz.

Colonel Sir Andrew Leith Hay.
John Augustus Lloyd, Esq.
Charles Henry Oakes, Esq., M.A.

List of Admissions into the Royal Society since the last Anniversary (1838).

On the Home List, viz.

Sir Thomas Dyke Acland, Bart., M.P.
George Barker, Esq.
Beriah Botfield, Esq.
Lord Carrington.
Arthur Conolly, Esq. (Captain, Bengal Service.)
Charles Darwin, Esq., M.A.
Edward Davies Davenport, Esq.
Henry Mangles Denham (Commander, R.N.).
Richard Drew, Esq.
Arthur Farre, M.B.
Thomas William Fletcher, Esq.
William James Frodsham, Esq.
The Rev. Thomas Gaskin, M.A.
George Godwin, jun., Esq.
John Thomas Graves, Esq., M.A.
Edwin Guest, Esq.
George Gulliver, Esq.
James Orchard Halliwell, Esq.
Peter Hardy, Esq.
James Heywood, Esq.
John Hilton, Esq.
John Hogg, Esq., M.A.
The Rev. Philip Kelland, M.A.
Gilbert Wakefield Mackmurdo, Esq.
The Rev. Samuel Roffy Maitland.
The Rev. Henry Mosely, M.A.
H. Alexander Ormsby (Lieutenant, Indian Navy).
Lieut.-Col. William Reid, R.E.
Robert Rigg, Esq.
William Sharpey, M.D.
Clement Swanston, Esq.
James Joseph Sylvester, Esq.
The Venerable Charles Thorp, D.D.
The Rev. Charles Turnor, M.A.
John Wesley Williams, Esq.
James Yates, Esq., M.A.

On the Foreign List, viz.

Louis Agassiz.
Christopher Hansteen.
Carl. Fried. Philip von Martius.
Macédoine Melloni.
Lambert Adolphe Jacques Quetelet.
Felix Savart.

The President then addressed the meeting as follows:

Gentlemen,

A year having now elapsed since you conferred upon me the highly honourable office of your President, it becomes my duty, in accordance with the example of my predecessors, to address you. The first and most agreeable part of my task is to express my feelings of gratitude to those Gentlemen whom you were pleased to select as my Council. I am most highly indebted to them for the zealous co-ope-

ration and hearty assistance which I have ever received at their hands. It is to them that I have looked to aid my inexperience, and to supply my manifold deficiencies, and I have not been disappointed. To those who are the more permanent officers of the Society, the Treasurer and the Secretaries, my obligations are particularly great, and I will venture to add, that to them, as well as to the other members of the Council, your thanks are due as well as mine.

The past year has indeed been to that portion of the Royal Society which takes an active part in its affairs, one of more than usual labour and exertion,—of labour and exertion, destined, as I hope, to produce rich and ample fruit. The great and marking peculiarity which has attended it, has been the sailing of the Antarctic Expedition. The importance of following up in the southern regions of the globe the magnetic inquiries so interesting to men of science in Europe, was strongly felt by one of our distinguished Fellows, Major Sabine, and by him brought before the notice of the British Association at their meeting at Newcastle, as he had also previously done at Dublin. That great assemblage of men of science, concurring in the views of Major Sabine, resolved to suggest to Her Majesty's Government the propriety of sending out a scientific expedition; and the Royal Society lost no time in warmly and zealously seconding the recommendation. It would, Gentlemen, be an idle inquiry to ask whether the success of the application be owing to the British Association or to the Royal Society. It would seem, indeed, probable, that, considering the financial difficulties of the time, the Government might have hardly considered itself justified in yielding to the prayers of either body separately on this occasion; and if to the British Association be the glory of the first proposal of this Expedition, to the Royal Society belongs the praise of perseverance in seconding the recommendation, and of laborious and earnest endeavours to aid in rendering it in every respect as efficient as possible. It is my duty as your President to return my thanks and yours to Lord Melbourne, Lord Minto, Lord Monteagle, Sir Hussey Vivian, and Sir Richard Jenkins, the Chairman of the Honourable Court of Directors of the East India Company, for the urbanity and kindness with which they have received and acted on the suggestion of your Council, and for the confidence which the Government reposed in us, when they asked for our assistance in instructing the officers to whom the Expedition has been entrusted.

In compliance with the request conveyed to us by the First Lord of the Admiralty, the Council transmitted to the Government a body of hints and instructions in different branches of science, which I trust are likely to be of material use both to the principal and to the subsidiary objects of the Antarctic Expedition.

These hints and instructions would have been far less extensive and efficient if the Council had not been able to have recourse to the several Scientific Committees, of whose formation the Society is already aware. The Expedition has now sailed, amply provided with the best scientific instruments and furnished with ample scientific instructions: it is commanded by one well acquainted both

with magnetic inquiry and nautical research. We may therefore hope that, with the blessing of Providence, it will return with a store of knowledge valuable to the geographer, to the geologist, to the meteorologist, and to him also who studies the marvels of vegetable and animal life. In addition to all this we may hope, that the main object of the Expedition will be accomplished by additional light thrown on the obscure problems which still attend the magnetism of the earth, and that by such discoveries Captain James Clark Ross may not only add to his own reputation and his country's glory, but also give to the adventurous mariner increased facility and security in traversing the pathways of the ocean.

The Antarctic Expedition was not the only measure recommended by the Royal Society and the British Association to Her Majesty's Government. Another important recommendation, which had previously been brought forward by Baron Humboldt, was the establishment of fixed magnetic observatories for the purpose of making simultaneous observations in different parts of our colonial possessions. These recommendations have been readily acceded to, both by the Government and by the Court of Directors of the East India Company, and probably, ere many months shall have elapsed, the observatories will be in full activity. This ready acquiescence in the wishes of men of science appears to me highly creditable to our statesmen; and I feel confident, that while science belongs to no party, on the other hand, every party in this country is fully aware of the importance of science, and of the numerous benefits conferred by it on the human race.

I have stated, Gentlemen, that your Council had recourse to the Scientific Committees for assistance in drawing up instructions for the Expedition in different branches of knowledge; those committees, who were named only two years ago, were at first apparently more a matter of form than substance; they have now been found capable of doing excellent service. Not only has your Council consulted them on the questions already alluded to, but also, observing that the several Committees are composed of the most competent judges of the merits of the memoirs in the respective departments of science communicated to the Society, they have, in general, referred the papers to them to report upon, previously to coming to a decision regarding their publication.

The Royal Society, from its character of pursuing every branch of physical science, is evidently in a different position from other societies professing some one science alone. It may be reasonably expected, that in the Botanical or Geological Society, for instance, the whole Council should possess a certain degree of botanical or geological knowledge. This, however, cannot be the case with us. Our Council will comprise a few astronomers, a few zoologists, a few botanists, and a few persons well acquainted with geology and medicine; but no single science can monopolize a large number of its members. In difficult questions we have therefore felt that it is more satisfactory to ourselves, and we think probably more so to the general body of the society, and to those who have favoured us

with papers, that we should ask the opinion of a larger number of men conversant with the immediate sciences in question. At the same time, the Council retains its responsibility for its acts, and the chief officers of the society are officially members of each of the scientific committees.

The Council have derived a further assistance from these Committees in the adjudication of our medals. In naming these Committees, the Council has had both a difficult and a delicate task. Convinced that bodies, when too numerous, are little adapted for business, they have also felt that the power of giving their attendance might be more important than absolute superiority of scientific attainments. Some members have, however, been selected, though really non-resident, because it was believed that their colleagues might wish to consult them by letter. With these objects and views, the Council have done their best; but they have little doubt that some gentlemen have been overlooked and omitted, whose presence in the Committees might have been very desirable. The Society must consider this as in some degree a new system, to be perfected and improved by experience alone.

Another question has occupied a share of the time of the Council during the last year. We have felt that the testimonial of recommendation for new Fellows has scarcely been sufficiently definite and precise in stating the grounds on which the candidate was recommended to the body of the Society. We have therefore thought it desirable to draw up forms of testimonial, some one of which may be adopted as most fit for each individual so recommended. We have thought this more fair, at the same time, to the meritorious candidate and to those electors who are otherwise left in the dark with respect to his claims for their suffrages. We hope and trust that this new regulation will not stand in the way of any candidate who would be a desirable addition to our number.

The labours of our tried and valuable officer, Mr. Roberton, having materially increased, partly in consequence of the establishment of Scientific Committees, and partly from other causes, and those labours having also become more valuable from the lengthened experience of many years spent in our service, it has appeared to us an act of mere justice to augment his salary from £160 to £200 per annum.

The Society are doubtless aware, that, at the time of the last Anniversary, no final settlement had taken place of the pecuniary claim of Mr. Panizzi, who had commenced the Catalogue of our Library, though that gentleman had received a considerable sum on account. Feeling that it was very desirable to bring this question to a termination, we agreed to a reference; and Mr. Drinkwater Bethune having been proposed by Mr. Panizzi, and agreed to by us, that gentleman has decided that a balance of £328 is still due by us.

The vacancies in the list of our Foreign Members have been supplied by the election of M. Savart of Paris, Signor Melloni of Parma, M. Quetelet of Brussels, M. Hansteen of Christiana, Prof.

Agassiz of Neufchatel, and M. von Martius of Münich, as those Fellows who were present at their election will remember.

I have to announce to you, Gentlemen, with great regret, the retirement of Captain Smyth from the office of Foreign Secretary, in consequence of his leaving his present residence for one at an inconvenient distance from London.

I shall not detain you by any observations of the finances of the Royal Society, as you will shortly hear the report of the Treasurer on that subject.

I have the honour, Gentlemen, to inform you that the Council have, by an unanimous decision, awarded the Royal Medals to Dr. Martin Barry and Mr. Ivory, and the Copley Medal for the year to Mr. Robert Brown; and I shall now beg leave to address myself to those three Gentlemen.

Dr. Barry—it gives me sincere pleasure to bestow this medal on a gentleman who has so well deserved it, by researches in a difficult and important portion of animal physiology*. Your merits have been appreciated by men much more capable of understanding the subject than I can pretend to be—by men selected by the Council of the Royal Society for their physiological science, who have felt the great value of the discoveries you have made by accurate and diligent research, aided by the skilful use of the microscope. I trust that the award of this medal will encourage you to persevere in the same course, and that future discoveries may add to your reputation and to that of the important profession to which you belong.

Mr. Ivory—it is not the first time that you have been addressed

* These researches are the subject of Dr. Martin Barry's papers "On Embryology," communicated to the Royal Society in 1838 and 1839.

In these memoirs the author has brought to light many new and interesting facts, and has repeated and confirmed previous observations regarding the nature, formation, and developement of the ovum in the vertebrata, and especially in the mammalia.

The importance of the subject and the difficulty of its investigation, render the establishment of facts previously known extremely acceptable to physiologists. But the novel matter contained in Dr. Barry's Memoirs forms a considerable proportion of them. Without entering into unnecessary detail, we may mention that the author has determined the order of formation of the different parts of the ovum, and the nature and mode of developement of the vesicle (ovisac), in which these processes take place. He has, in like manner, discovered the nature and traced the developement of the so-called disc of M. Baer, and has detected in it the mechanism which mainly regulates the transit of the ovum into the Fallopian tube. The second series of Dr. Barry's observations makes known the changes which the ovum undergoes in its passage through the Fallopian tube; the earliest and most interesting stages of developement being for the first time described in this memoir.

The value of his very laborious and extensive series of minute observations is greatly enhanced by the clearness and method with which the results are given, and by the comparisons, which the author's intimate acquaintance with this branch of physiological literature has enabled him to institute, between his own observations and those of his predecessors in the same branch of inquiry.

from this chair, and it gives me great satisfaction to follow the steps of my predecessors, Sir Joseph Banks and Sir H. Davy, by again bestowing a medal on one who is an honour to the Royal Society and pre-eminently distinguished for his mathematical attainments. The labours of your life are too well known to the scientific world to require any eulogium from me, and I consider that in this tribute to your paper on astronomical refraction, we are rather doing an honour to ourselves than to you.

Mr. Brown—in conferring the Copley Medal on you for your valuable discoveries in vegetable impregnation*, I am quite sure that the voice of scientific Europe will respond to the decision of the Council of the Royal Society. The Académie des Sciences has already pronounced on your merits, as also on those of Mr. Ivory, by electing you as well as that gentleman to a seat among their foreign members; and the University of Oxford has also, by an honorary degree, given you a similar testimonial. That you are one of our fellows is to myself a circumstance peculiarly agreeable, as it must be to the whole body over whom I have the honour to preside. Your discoveries in the particular botanical question, for which I have to give you the Copley Medal, are so important, not only in a botanical, but also in a general scientific point of view, by showing the close analogies of animal and vegetable life, that the Committee of Zoology have felt it as much their province as that of the Committee of Botany, to recommend that the Copley Medal should be bestowed upon you; and the Council have come to an unanimous resolution to give it, though at the same time other gentlemen were recommended by other scientific committees, with whom even an unsuccessful rivalry would be no mean praise.

I hope, Mr. Brown, that you may long enjoy life and leisure to pursue researches so valuable to science and so honourable to the country of which you are a native.

In drawing up the following notice of the losses which the Royal Society has sustained during the last year, in conformity with the practice of my predecessors, I have availed myself of the assistance of one of the Fellows, whose acquaintance with the labours of men of science peculiarly qualified him for the execution of a task which I could not myself have ventured to undertake. I therefore will not longer occupy your time by any further remarks of my own, but will conclude by the expression of my present wishes for the prosperity of the Royal Society, and for its success in furthering the noble ends for which it was instituted.

The Rev. Martin Davy was originally a member of the medical profession, which he followed, during a great part of his life, with no inconsiderable reputation. He became a medical student of

* The following are the discoveries referred to: viz., the organization of the vegetable ovule, immediately before fecundation, (published in 1826); and the direct action of the pollen, manifested by the contact established between it and that point of the ovulum where the embryo subsequently first becomes visible, and published in papers, in the years 1832 and 1833, and communicated to the Linnean Society.

Caius College in 1787, and was elected to a fellowship in 1793 and to the mastership in 1803, the late illustrious Dr. Wollaston being one of his competitors. One of the first acts of his administration was to open his College to a more large and liberal competition, by the abolition of some mischievous and unstatutable restrictions, which had been sanctioned by long custom, and also by making academical merit and honours the sole avenue to college preferment: and he lived to witness the complete success of this wise and liberal measure, in the rapid increase of the number of high academical honours which were gained by members of his College, and by the subsequent advancement of many of them to the highest professional rank and eminence.

Some years after his accession to the mastership, he took holy orders and commuted the degree of Doctor in Medicine for that of Theology, and in later life he was collated to some considerable ecclesiastical preferments. Dr. Davy had no great acquaintance with the details of accurate science, but he was remarkable for the extent and variety of his attainments in classical and general literature; his conversation was eminently lively and original, and not less agreeable from its occasional tendency to somewhat paradoxical, though generally harmless speculations. He died in May last, after a long illness, deeply lamented by a large circle of friends, to whom he was endeared by his many social and other virtues.

Dr. Herbert Marsh, Bishop of Peterborough, and one of the most acute and learned theologians of his age, became a member of St. John's College in the University of Cambridge in the year 1775 and took his B.A. degree in 1779, being second in the list of Wranglers, which was headed by his friend and relation Mr. Thomas Jones, a man whose intellectual powers were of the highest order, and who for many years filled the office of tutor of Trinity College with unequalled success and reputation. Soon after his election to a fellowship, he went to Germany, where he devoted himself during many years to theological and general studies, and first became known to the public as the translator and learned commentator of Michaelis's Introduction to the New Testament. It was during his residence abroad that he published in the German language various tracts in defence of the policy of his own country in the continental wars, and more particularly a very elaborate "History of the Politics of Great Britain and France, from the time of the Conference at Pilnitz to the Declaration of War," a work which produced a marked impression on the state of public opinion in Germany, and for which he received a very considerable pension on the recommendation of Mr. Pitt. In 1807, he was elected Lady Margaret's Professor of Divinity in the University of Cambridge, an appointment of great value and importance, which he retained for the remainder of his life. On the resumption of his residence in the University, he devoted himself with great diligence to the preparation of his lectures on various important branches of Divinity, interposing a great number of occasional publications on the Catholic Question, the Bible Society, and various other subjects of political and theological contro-

versy. In 1816 he was appointed Bishop of Llandaff; and three years afterwards he was translated to the see of Peterborough. In the course of a few years from this time, his health, which had been already undermined by his sedentary habits and severe studies, began rapidly to decline, and he was compelled to abstain from the active duties of his professorship and from the exciting labours of controversy; and though his infirmities continued to increase both in number and severity, yet his life was prolonged to a mature old age by the vigilant and anxious care and nursing of one of the most exemplary and affectionate of wives.

Dr. Marsh was a man of great learning and very uncommon vigour of mind, and as a writer, remarkable for the great precision of his language and his singular clearness in the statement of his argument. His lectures on Divinity are a most valuable contribution to the theological student, and his "Comparative View of the Churches of England and Rome" presents one of the most masterly views of the great principles which distinguish those churches, which has ever appeared from the pen of a Protestant writer. His controversial writings, though generally full of acuteness and ability, must be expected to share the fate of all productions which are not kept from perishing by the permanent existence of the interests, of whatever nature, which gave rise to them: and we may justly lament that learning and powers of reasoning of so extraordinary a character, were not more exclusively and steadily devoted to the completion of more durable and systematic theological labours.

The father of the late PROFESSOR RIGAUD had the care of the King's Observatory at Kew, an appointment which probably influenced the early tastes and predilections of his son. He was admitted a member of Exeter College, Oxford, in 1791, at the early age of sixteen, and continued to reside there as fellow and tutor until 1810, when he was appointed Savilian Professor of Geometry. He afterwards succeeded to the care of the Radcliffe Observatory, and the noble suite of instruments by Bird, with which it is furnished, was augmented, on his recommendation, by a new transit and circle, so as to fit it for the most refined purposes of modern practical astronomy: and we venture to express a hope that it will shortly become equally efficient and useful with the similar establishment which exists in the sister university.

Professor Rigaud published, in 1831, the miscellaneous works and correspondence of Bradley, to which he afterwards added a very interesting supplement on the astronomical papers of Harriott. In 1838, he published some curious notices of the first publication of the Principia of Newton; and he had also projected a life of Halley, with a view of rescuing the memory of that great man from much of the obloquy to which it has been exposed; he had made extensive collections for a new edition of the mathematical collections of Pappus; and he was the author of many valuable communications to the Transactions of the Royal Astronomical Society, and to other scientific journals, on various subjects connected with physical and astronomical science. There was probably no other person of

his age who was equally learned on all subjects connected with the history and literature of astronomy.

Professor Rigaud was a man of most amiable character, and of singularly pleasing manners and person. The warmth of his affections, his modesty, gentleness, and love of truth, as well as the great variety of his acquirements and accomplishments, had secured him the love and the respect of a large circle of friends, not merely in his own university, but amongst men of science generally. He died in London in March last, after a short but painful illness, which he bore with a fortitude and resignation which might have been expected from his gentle, patient, and truly Christian character.

Mr. Wilkins, Professor of Architecture to the Royal Academy, became a member of Caius College, Cambridge, in 1796, and took the degree of B.A. in 1800, his name standing sixth on the mathematical Tripos. He was soon afterwards nominated one of Wort's Travelling Bachelors, and also a fellow of his college, and passed four years in Greece and Italy, studying the architectural remains and monuments of those countries with great diligence, preparatory to the practice of his profession as an architect, which his father had followed with credit, and for which his great skill as a draftsman particularly qualified him. The study of those matchless creations of ancient art would appear to have exercised a powerful influence on his taste, and to have led him to prefer the purer forms of Grecian architecture to the more varied imitations and adaptations of them which appeared in the works of the Romans or in those of the great masters of modern Italy and more particularly of Palladio;—and the influence of these predilections was sufficiently visible in his designs for the East India College at Haileybury, and for Downing College, Cambridge, and is more or less easily traceable in most of his subsequent works. In 1807, he published his "Antiquities of Magna Græcia," a magnificent work, containing descriptions, views, measurements, and restorations of the chief remains of Syracuse, Agrigentum, Ægesta, and Pæstum. At a subsequent period he published "Atheniensia," or Remarks on the Buildings of Athens, in which he expressed opinions unfavourable to those commonly entertained respecting the rank which the Elgin marbles, which had been only recently purchased by the nation, should be considered to hold when viewed as works of art: he was likewise the author of a translation of the Civil Architecture of Vitruvius, including those books which relate to the public and private edifices of the Ancients, which was preceded by a learned introduction on the history of the Rise and Progress of Grecian Architecture,—a work which was chiefly designed to show that the precepts of Vitruvius referred to Grecian and not to Roman buildings.

The publication of these works and of some essays in the Archæologia, which showed a profound knowledge of the principles both of Grecian and Gothic architecture, led to very extensive professional engagements, particularly in the University of Cambridge, where he rebuilt Corpus Christi and King's colleges, and made extensive additions to Trinity College: he was likewise the

author of the magnificent portico of London University College, the National Gallery, and of other important edifices in London. He was latterly compelled by the declining state of his health and by repeated attacks of the gout, to retire from his professional engagements, though he did not abandon those studies which had formed his delight and occupation from his earliest years. In 1837, he published his "Prolusiones Architectonicæ, or Essays on subjects connected with Grecian and Roman Architecture," which were designed, in some degree, as a substitute for those lectures, which, under other circumstances, he would have been called upon to deliver, as Professor of Architecture, to the students of the Royal Academy. During the last year of his life, though constantly confined to his bed, and extremely weakened and emaciated by disease, he still continued his favourite pursuits until within a few days of his death, which took place on the last day of August last.

The Rev. Archibald Alison, senior Minister of St. Paul's Chapel, Edinburgh, was born in 1757, became a member of the University of Glasgow in 1772, and of Baliol College, Oxford, in 1775, and took the degree of B.C.L. in 1784: he soon afterwards took holy orders in the English Church, and was presented to several ecclesiastical preferments by Sir William Pulteney, Lord Chancellor Loughborough, and Bishop Douglas of Salisbury. In 1784 he married the daughter of the celebrated Dr. John Gregory of Edinburgh, with whom he lived in uninterrupted happiness for forty years of his life. His celebrated Essay "on the Nature and Principles of Taste" was first published in 1790, and speedily became incorporated into the standard literature of Great Britain. Towards the close of the last century, he became a permanent resident in his native city as minister of the Episcopal chapel, Cowgate, and afterwards of St. Paul's, where he was connected by congenial tastes and pursuits with Dugald Stewart, Playfair, Henry Mackenzie, Dr. Gregory, and the many other distinguished men who, during so many years, made that beautiful and picturesque city the metropolis of British literature. In 1814, he published two volumes of sermons; and at a later period, a very interesting memoir of his accomplished friend the Hon. Fraser Tytler Lord Woodhouslee. Mr. Alison was a man of very pleasing and refined manners, of great cheerfulness and equanimity of temper, of a clear and temperate judgment, and possessing a very extensive knowledge of mankind. He was habitually pious and humble-minded, exhibiting, in the whole tenor of his life, the blessed influence of that Gospel of which he was the ordained minister. All his writings are characterized by that pure and correct taste, the principles of which he had illustrated with so much elegance and beauty.

Edmund Law Lushington was born in 1766, at the lodge of St. Peter's College, Cambridge, of which his grandfather, Bishop Law, was master. He became a student, and afterwards a fellow of Queen's College in that University, and attained the fourth place on the mathematical tripos in 1787. After practising for some years at the bar, he was appointed Chief Justice of Ceylon, a station

which he filled for several years with great advantage to that colony. On his return from the East, he was made Auditor of the Exchequer, and also received from his uncle Lord Ellenborough the appointment of Master of the Crown Office. He was an intimate friend of Wollaston and Tennant; and though withdrawn by his pursuits from the active cultivation of science, he continued throughout his life to feel a deep interest in its progress. His acquaintance with classical and general literature was unusually extensive and varied, and he had the happiness of witnessing in his sons the successful cultivation of those studies which other and more absorbing duties had compelled him to abandon. Mr. Lushington was a man of a cheerful temper, of very courteous and pleasing manners, temperate and tolerant in all his opinions, and exemplary in the discharge both of his public and private duties: few persons have ever been more sincerely beloved either by their friends or by the members of their families.

Mr. George Saunders was formerly architect to the British Museum, where he built the Townley Gallery: he was also a diligent and learned antiquary, and the author of a very interesting and valuable paper in the twenty-sixth volume of the Archæologia, containing the results of an inquiry concerning the condition and extent of the city of Westminster at various periods of our history.

The only foreign members whom the Royal Society has lost during the last year are the Baron de Prony, one of the most distinguished engineers and mathematicians of the age; and the venerable Pierre Prevost, formerly Professor of Natural Philosophy in the University of Geneva.

Gaspard Clair Francois Marie Riche de Prony was born in the department of the Rhone in 1755, and became a pupil, at an early age, of the Ecole des Ponts èt Chaussées, where he pursued his mathematical and other studies with great application, and with more than common success. He was subsequently employed, as an adjunct of M. Perronet, the chief of that school, in many important works, and particularly in the restoration of the Port of Dunkirk; and in 1786, he drew up the engineering plan for the erection of the Pont Louis XVI., and was employed in superintending its execution. M. de Prony had already appeared before the public, first as the translator of General Roy's "Account of the Methods employed for the Measurement of the Base on Hounslow Heath," which was the basis of the most considerable geodesical operation which had at that time been undertaken; and subsequently, as the author of an essay of considerable merit, "On the Construction of Indeterminate Equations of the Second Degree." In 1790 and 1797, appeared his great work, in two large volumes, entitled *Nouvelle Architecture Hydraulique*, which is a very complete and systematic treatise on Mechanics, Hydrostatics and Hydraulics, and more particularly on the principles of the steam-engine and hydraulical engineering. In 1792 he was appointed to superintend the execution of the Cadastre, or great territorial and numerical survey of France, —a gigantic undertaking, the subsequent execution of which, during

the revolutionary government, combined with the establishment of the bases of the decimal metrical system, gave employment and developement to so many and such important scientific labours and discoveries: among many other laborious duties, the formation of the extensive tables devolved upon M. de Prony, who, in the course of two years, organized and instructed a numerous body of calculators, and completed the immense *Tables du Cadastre*, which are still preserved in MSS. at the library of the Observatory in seventeen enormous folio volumes.

M. de Prony became Directeur-Général des Ponts et Chaussées in 1794, and was nominated the first Professor of Mechanics to the Ecole Polytechnique;—an appointment, which led to the publication of many very important memoirs on mechanical and hydraulical subjects, and on various problems of engineering, which appeared in the Journal of that celebrated school. He declined the invitation of Napoleon to become a member of the Institute of Egypt,—a refusal which was never entirely forgotten or pardoned. In the beginning of the present century he was engaged in the execution of very extensive works connected with the embankments towards the embouchure of the Po, and in the ports of Genoa, Ancona, Pola, Venice, and the Gulf of Spezzia; and in 1810, he was appointed, in conjunction with the celebrated Count Fossombroni of Florence, the head of the *Commissione de l'Agro Romano*, for the more effectual drainage and improvement of the Pontine Marshes. The result of his labours in this very important task, which he prosecuted with extraordinary zeal and success, was embodied in his *Déscription Hydrographique et Historique des Marais Pontins*, which appeared in 1822, which contains a very detailed description of the past, present and prospective condition of these pestilential regions, and a very elaborate scientific discussion of the general principles which should guide us, in this and all similar cases, in effecting their permanent restoration to healthiness and fertility.

After the return of the Bourbons, M. de Prony continued to be employed in various important works, and more particularly in the formation of some extensive embankments towards the mouth of the Rhone. In 1817, he was made a member of the *Bureau des Longitudes*, and in the following year he was elected one of the fifty foreign members of the Royal Society: in 1828, he was created a Baron by Charles X., and was made a peer of France in 1835. He died in great tranquillity at Aonières near Paris, in July last, in the 84th year of his age.

The Baron de Prony was a man of singularly pleasing manners, of very lively conversation, and of great evenness of temper. He was one of the most voluminous writers of his age, generally upon mathematical and other subjects connected with his professional pursuits; and though we should not be justified in placing him on the same level with some of the great men with whom he was associated for so many years of his life, yet he is one of those of whom his country may justly be proud, whether we consider the extent and character of his scientific attainments, or the great variety of important practical and useful labours in which his life was spent.

Pierre Prevost was born in 1751, and was originally destined to follow the profession of his father, who was one of the pastors of Geneva: at the age of twenty, however, he abandoned the study of theology for that of law, the steady pursuit of which, in time, gave way to his ardent passion for literature and philosophy: at the age of twenty-two, he became private tutor in a Dutch family, and afterwards accepted a similar situation in the family of M. Delessert, first at Lyons, and afterwards at Paris. It was in this latter city that he commenced the publication of his translation of Euripides, beginning with the tragedy of Orestes;—a work which made him advantageously known to some of the leading men in that great metropolis of literature, and led to his appointment, in 1780, to the professorship of philosophy in the college of Nobles, and also to a place in the Academy of Berlin, on the invitation of Frederick the Great. Being thus established in a position where the cultivation of literature and philosophy became as much a professional duty as the natural accomplishment of his own wishes and tastes, he commenced a life of more than ordinary literary activity and productiveness. In the course of the four years which he passed at Berlin, he published *Observations sur les méthodes employées pour enseigner la morale; sur la théorie des gains fortuits; sur le mouvement progressif du centre de gravité de tout le système solaire; sur l'origine des vitesses projectiles; sur l'économie des anciens gouvernements; sur l'état des finances d'Angleterre;* and he also completed the three first volumes of his translation of Euripides. There were, in fact, few departments of literature or philosophy which were not comprehended in the extensive range of his studies and publications.

In the year 1784, he returned to Geneva to attend the death-bed of his father, when he was induced to accept the chair of belles lettres in the University,—an appointment, which he found on trial little suited to his taste, and which he shortly afterwards resigned. For some years after this period, he was compelled more by circumstances than by inclination to partake largely in those political discussions, which, for some years, agitated his native city, and which afterwards, resumed upon a wider theatre, shook to its centre the whole framework of European society; but he gradually withdrew himself from political life on his appointment to the chair of natural philosophy in 1792, and devoted himself from thenceforth, with renewed activity and ardour, to pursuits which were most congenial to his tastes.

In 1790 M. Prevost published his *Mémoire sur l'équilibre du feu*, and in the following year his *Recherches sur la chaleur*: these important memoirs were followed by many others on the same subject in various scientific journals; and the general results of all his researches and discoveries were exhibited, in a systematic form, in his well-known work *Sur le calorique rayonnant*, which was published in 1809, and in which he fully developed his *Theory of Exchanges*, and was enabled to give a consistent explanation of the principal facts which were at that time known respecting the nature and propagation of heat.

It would be impossible, in the very short compass within which this notice is necessarily confined, to enumerate even a small part of the publications of an author whose pursuits were so various and whose labours were so unremitting. He contributed papers to our Transactions in 1797 and 1803; the first containing an explanation of some optical experiments of Lord Brougham, and the second, some remarks on heat and on the action of bodies which intercept it, with reference to a paper by Dr. Herschel; and in 1806, he became one of the foreign members of our body. In 1799, he obtained the first *accessit* for an essay *Sur l'influence des signes rélativement à la formation des idées*, which was written for a prize, adjudged to the celebrated Degerando, proposed by the Institute of France; and he was shortly afterwards elected a corresponding member of that body. His *Essais de philosophie, et études de l'esprit humain*, appeared in 1804, to which were appended some very remarkable Essays of his friend and ancient preceptor Le Sage, of whom he published a most interesting life in the following year. He likewise published, in very rapid succession, translations of the Rhetoric of Blair, the Essays and posthumous works of Adam Smith, the Elements of Philosophy of Dugald Stewart, the essay on Population by Malthus, Salt's Travels in Abyssinia, the Conversations on Political Economy, of his wife's sister-in-law, Mrs. Marcet, and many other works of less importance and interest.

In 1823, at the age of 72, though still vigorous and active both in body and mind, he resigned the professorship of natural philosophy, in wise anticipation of the approach of that period of life when men naturally feel reluctant to acknowledge the decline of their faculties, or incompetent to perceive it. From this time, though still consulted by his colleagues and fellow-citizens on every important subject connected with the Academy or the state, he retired into the bosom of his family, which contained within itself, in a very uncommon degree, every element of tranquillity, contentment and happiness. His own temper was singularly equable and tranquil; and his tastes and pursuits, which rarely left his time unoccupied, saved him from that *tædium vitæ* which sometimes renders old age querulous and discontented. Thus happily disposed and happily circumstanced, it is not wonderful that his life should have been prolonged beyond the ordinary limits of humanity. He died on the 8th of April, in the 88th year of his age, surrounded by his family, and deeply regretted by all who knew him.

The philosophical character of M. Prevost had been greatly influenced by that of his master Le Sage, a man of great originality and profundity of thought, but whose speculations, particularly those which attempted the explanation of the cause of gravity, trespassed somewhat beyond the proper limits of philosophy. We consequently find him disposed to explain the laws of the propagation of heat and light on the most simple mechanical principles, and to trace their origin and progress much farther than the experiments or facts will properly warrant; thus giving to his conclusions, in many cases, a much more hypothetical character than would otherwise have at-

tached to them. M. Prevost had little acquaintance with the more refined resources of modern analysis; and his researches on many important branches of experimental and philosophical inquiry were consequently limited to reasonings which could be carried on by the most simple algebraical or geometrical processes. But notwithstanding the restrictions which were thus imposed on his progress, the range of his philosophical researches was unusually extensive and various, and his discoveries on heat must always be considered as constituting a most important epoch in a branch of science which has recently received so extraordinary a developement in the hands of Fourier, Forbes, Melloni, and other philosophers.

The Treasurer read the following statement relative to the finances of the Society:

The Disbursements of the Society may be classed under two heads:

1. Those which are *ordinary*; and
2. Those which are *extraordinary*, and not likely to recur.

1. The ordinary disbursements may be stated in the following manner:—

Salaries	£525
Lighting	40
Coals	30
Taxes and Parish Rates	50
Charwoman	30
Postage	20
Fire Insurance	22
Miscellaneous	200
	£917

The annual expense of printing the Philosophical Transactions has been, on an average of the last five years, £850, without including the charge for stitching and for advertisements; viz.

For Printing	£466*
For Paper	142
For Engraving	242
	£850

The expenses attending their publication vary, of course, very much according to the number of pages, the quantity of Engravings, and the nature of the Papers included in each volume.

2. Besides the ordinary disbursements, the Society has recently borne the expenses of the Catalogue, for which Mr. Panizzi has al-

	Printing.	Paper.	Engraving.
* 1839	£466 1 6	£170 0 0	£243 19 0
1838	361 19 3	56 5 0	146 18 6
1837	590 19 11	153 4 0	328 2 3
1836	340 10 6	207 4 0	397 12 3
1835	534 3 6	67 7 6	87 6 0

ready received £475 (including £28 paid to Mr. Roberton), which with £328 awarded by Mr. Drinkwater Bethune, to whom this matter was referred, is £803, and the expense of printing the same has been £657 : 10. The legal expenses in the present year have been greater than usual, in consequence of the costs in the above reference, amounting to £48 : 10 : 6, and those in the matter of the Royal Society *v.* Loscombe, amounting to £114 : 12 : 10, which have been incurred in prosecuting, under the advice of Counsel, the claim of the Society to £1200 3 per cent. consols bequeathed to the Royal Society by the late Sir Clifton Wintringham, payable on the death of his widow.

The expenses of defending the suit in respect of the Mablethorpe tithes have been considerable; and in consequence of the decision of Lord Abinger in the Court of Exchequer in July last, the income which the Society derives from that estate will be materially diminished, unless that decision can be reversed by appeal to the House of Lords.

The Society derives Income from the rent of an estate at Mablethorpe in Lincolnshire; from a fee-farm rent issuing out of the Barony of Lewes, in Sussex; from the rent of an estate at Acton; and one fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's Will. These rents are as follows:

Estate at Mablethorpe	£107	0	0
Lands at Acton	60	0	0
Fee-farm rent of lands in Sussex ..	19	4	0
Estate at Lambeth Hill	3	0	0
	£189	4	0

The estate at Mablethorpe consists of 55 a. 2 r. 2 p. of pasture land, and is let to Mr. Cross, at £107 per annum, who is tenant at will. The lands at Acton appear to consist now of 33 a. 3 r. 36 p., and are let to Mr. Essex, at £60 per annum, who is tenant at will.

The property at Acton was purchased by the Society, with other lands since sold, in August 1732.

The lands at Mablethorpe were bequeathed to the Society by Francis Aston, Esq. in 1713.

The fee-farm rent in Sussex issuing out of the Barony of Lewes was purchased by the Society with £400 bequeathed to the Society by the Bishop of Chester in June 1674, and is now payable by the Earl of Abergavenny.

The Society also derives income from

Dividends in Stock	£529	11	2
*Quarterly and Weekly Contributions about	667	0	0
Sale of Philosophical Transactions about ..	350	0	0

also whatever may be received for the Admission Fees, or Composition of new members, which is fluctuating. The Admissions have been on an average of the last five years thirty-four, which would give £340 per annum for Admission Fees of £10 each; and the average sums received from members who have compounded for

* This sum is on the increase.

annual contributions during the same period is £500, making a total of £840 per annum for Admission Fees and Compositions*.

Besides these sources of income, there are other sums invested in the funds, namely,

The Fairchild fund ..	£ 100	0	0	New South Sea Stock.
The Rumford fund ..	2292	11	7	Consols.
The Donation fund ..	4150	0	0	Consols.

of which the dividends are not applicable to the general expenses of the Society, but must be disposed of according to the intention of the respective donors.

The clear annual *income*, therefore, which may for some time be expected, without taking into consideration the sums arising from the Fairchild Fund, the Rumford Fund, and the Donation Fund, is about £2386, or without the Admission Fees and Compositions £1546, and the probable amount of *ordinary* expenses £1767.

J. W. LUBBOCK, *Treasurer*.

The statutes relating to elections were then read by the Secretary.

Joseph Smith, Esq. and E. H. Locker, Esq. were appointed Scrutators to assist the Secretaries in examining the balloting lists.

The ballot was then taken, and Dr. Roget, on the part of the Scrutators, reported the following gentlemen as being duly elected Officers and Council for the ensuing year:—

President.—The Marquis of Northampton.

Treasurer.—John William Lubbock, Esq., M.A.

Secretaries.—Peter Mark Roget, M.D.; Samuel Hunter Christie, Esq., M.A.

Foreign Secretary.—John Frederic Daniell, Esq.

Other Members of the Council.—Francis Baily, Esq.; Sir John Barrow, Bart.; Thomas Bell, Esq.; John Davy, M.D.; Bryan Donkin, Esq.; Edward Forster, Esq.; Thomas Galloway, Esq., M.A.; Thomas Graham, Esq.; Sir John F. W. Herschel, Bart., M.A.; Francis Kiernan, Esq.; John Lindley, Esq., Phil.D.; Richard Owen, Esq.; Richard Phillips, Esq.; Major Edward Sabine, R.A.; John Taylor, Esq.; Robert Bentley Todd, M.D.

The thanks of the meeting were given to the Scrutators for their trouble in examining the list.

The President having quitted the Chair, it was taken by the Rev. W. Whewell, and it was unanimously resolved that the thanks of the meeting be given to the Marquis of Northampton for the zeal he has displayed in promoting the interest of the Royal Society.

	Admissions.	Compositions.
* 1839	£360......36	£640......11
1838	320......32	540...... 9
1837	230......23	420...... 7
1836	290......29	500...... 9
1835	400......40	500......11

The following is the statement with respect to the Receipts and Payments of the Society during the preceding year, which was laid on the table by the Treasurer:—

Statement of the Receipts and Payments of the Royal Society between Nov. 29, 1838, *and Nov.* 28, 1839.

Receipts:—	£.	s.	d.	£.	s.	d.
Balance in the hands of the Treasurer at the last Audit ..				1463	14	5
28 Weekly Contributions, at one shilling				72	16	0
159 Quarterly Contributions, at £1:—						
141 Annual Contributions at £4	564	0	0			
One Reinstated (Two Annual Payments)..	8	0	0			
Six elected before the last Anniversary....	6	0	0			
Two elected before March 25th, 1839	8	0	0			
Eight elected after March 25th, 1839	8	0	0			
				594	0	0
36 Admission Fees				360	0	0
1 Composition for Annual Payment at £40				40	0	0
10 Compositions for Annual Payments at £60...........				600	0	0
Rents:—						
One year's rent of estate at Mablethorpe: due at Michaelmas, (less the expenses of defending the Tythe suit, £55. 13. 3)......	51	6	9			
One year's rent of lands at Acton: due at Michaelmas, 1839	60	0	0			
One year's fee-farm rent of lands in Sussex; land-tax deducted: due at Michaelmas, 1839	19	4	0			
One fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's will: due at Midsummer, 1839	3	0	0			
				133	10	9
Dividends on Stock:—						
One year's dividend on £14,000 Reduced 3 per cent. Annuities	420	0	0			
Dividend on £3452. 1. 1 Consols, the produce of the sale of the premises in Coleman-street............................	103	11	2			
One year's dividend on £200 Consols	6	0	0			
Donation Fund.						
One year's dividend on £4150. 0. 0 Consols	124	10	0			
Rumford Fund.						
One year's dividend on £2161. 0. 10 Consols	64	16	6			
One half year's dividend on £131. 10. 9....	1	19	6			
Fairchild Fund.						
One year's dividend on £100 New South Sea Annuities	3	0	0			
				723	17	2
Miscellaneous Receipts:—						
Sale of Philosophical Transactions, Abstracts of Papers, and Catalogue of the Royal Society's Library				286	13	0
Sale of Catalogue to Subscribers....................				75	0	0
Total Receipts				£4349	11	4

Payments :—	£.	s.	d.	£.	s.	d.
Fairchild Lecture.—The Rev. J. J. Ellis, for delivering the Fairchild Lecture for 1839				3	0	0
Bakerian Lecture.—William Snow Harris, Esq., for the Bakerian Lecture for 1839				4	0	0
Rumford Fund.—						
James D. Forbes, Esq., Two years' dividend on the Rumford Augmentation Fund, January 9, 1839				73	13	0
Cost of £131. 10. 9 Annuities				121	13	6
Mr. Wyon, for Gold and Silver Rumford Medal				64	0	0
British Museum Fund. For Books				38	2	6
Salaries :—	£.	s.	d.			
Dr. Roget, one year, as Secretary	105	0	0			
S. H. Christie, Esq., one year, as Secretary	105	0	0			
Ditto for Index to Phil. Trans.	5	5	0			
Capt. Smyth, one year, as Foreign Secretary	20	0	0			
Mr. Roberton, one year, as Assistant-Secretary	200	0	0			
Mr. W. E. Shuckard, one year, as Librarian	50	0	0			
Mr. Holtzer, one year, as Porter	30	0	0			
Ditto, for extra Porterage	10	0	0			
				525	5	0
Fire Insurance, on the Society's Property				22	11	6
Mrs. Coppard: Gratuity				10	0	0
Bills :—						
Taylor:						
Printing the Phil. Trans., 1838, part 2	212	1	6			
Ditto, 1839, part 1; Proceedings, Nos. 34—39; Circulars, Lists of Fellows, Ballot-lists, Statement of Payments, and Minutes of Council; &c. &c.	254	0	0			
Ditto, for the completion of the Catalogue	257	10	0			
Bowles and Gardiner:						
For Paper for the Phil. Trans., 1838, part 2, and 1839, part 1	170	0	0			
Basire:						
For Engraving and Copper-plate Printing for Phil. Trans., 1838, part 2	109	4	0			
Ditto, 1839, part 1, &c.	134	15	0			
Gyde:						
Boarding and Sewing 800 Parts of Phil. Trans. 1838, part 2, and 323 Catalogues	42	18	0			
Ditto, 1839, part 1, and 75 Catalogues	31	1	8			
				1211	10	2
Chappell:						
For Stationery	13	16	0			
Saunderson:						
For Shipping Expenses	7	5	8			
Carried forward	21	1	8	1232	11	10

	£.	s.	d.	£.	s.	d.
Brought forward..	21	1	8	1232	11	10
Brecknell and Turner:						
Wax Lights, Candles, and Lamp Oil	37	4	0			
Cubitt:						
For Repairing Windows, Carpets, &c.....	12	18	4			
Exchequer Fee for paying dividend	0	13	0			
Arnold:						
For Coals	17	2	11			
Murray:						
For taking Meteorological Observations ..	7	0	0			
Tuckett:						
Bookbinding	21	0	3			
Silvester:						
For New Diploma Plate	11	11	0			
Snell:						
For Repairs in the Library in 1835 and 1836	33	18	3			
Wood:						
For Coals (Porter's yearly allowance)....	6	4	0			
Few, Hamilton and Few, Solicitors:						
Law Expenses	178	5	2			
				346	18	7
Taxes and Parish Rates:						
Land and Assessed Taxes............	4	6	9			
Poor Rate	22	13	4			
Church Rate	9	4	2			
Rector's Rate	2	2	6			
				38	6	9
Petty Charges:						
Sewer's Rate......................	0	15	0			
Hartnup: for Barometrical Tables	2	2	0			
Silvester: for 12 Copies of Diploma ..	2	12	0			
Arnold and Dent: Attending Clocks ..	1	8	6			
Gwillim: Mats, Brushes, Fire wood, &c.	3	12	3			
Parker: for Packing Cases	1	5	1			
Cobbett: for Glazing	1	0	6			
Charwoman's Wages	27	6	0			
Ditto, Extra work	2	0	0			
Stamps..........................	0	14	6			
Postage and Carriage	15	14	1			
Expenses on Foreign Packets, &c.	5	19	4			
Window-cleaning, &c.	2	11	0			
Miscellaneous expenses	15	0	6			
				82	0	9
Total Payments....				£2541	1	9
Total Receipts				4349	11	4
Balance in the hands of the Treasurer				£1808	9	7

November 28th, 1839.

JOHN WILLIAM LUBBOCK, *Treasurer.*

The Balances in hand, now belonging to the several trusts, are as under: viz:—

	£.	s.	d.
British Museum Fund	165	11	10
Donation Fund	358	6	4
Rumford Fund	66	16	0

The following table shows the progress and present state of the Society, with respect to the number of Fellows:—

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2. 12. Annually.	Paying £4 Annually.	Total.
November, 1838 ..	11	44	561	29	144	789
Since elected......	......	6	10	......	26	42
Since re-instated ..	......	......	......	+1	+1	2
Since compounded	......	......	+ 1	......	−1	
Since deceased, &c.	......	−2	−16	−3	−1	−22
Defaulters	......	......	......	......	−3	−3
November, 1839	11	48	556	27	166	808

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1839. No. 41.

December 5, 1839.

FRANCIS BAILY, Esq., V.P., in the Chair.

John Rogers, Jun., Esq. was balloted for, and duly elected into the Society.

No paper read.

December 12, 1839.

MAJOR SABINE, R.A., V.P., in the Chair.

George Leith Roupell, M.D., was balloted for, and duly elected into the Society.

"On the Nerves of the Gravid Uterus." By Robert Lee, M.D., F.R.S.

The author, while dissecting a gravid uterus of seven months, on the 8th of April, 1838, observed the trunk of a large nerve proceeding upwards from the cervix to the body of that organ along with the right uterine vein, and sending off branches to the posterior surface of the uterus; some of which accompanied the vein, and others appeared to be inserted into the peritoneum. A broad band, resembling a plexus of nerves, was seen extending across the posterior surface of the uterus, and covering the nerve about midway from the fundus to the cervix. On the left side, a large plexus of nerves was seen, surrounding the uterine veins at the place where they were about to enter the hypogastric vein. From this plexus three large trunks of nerves were seen accompanying the uterine vein, which increased in size as they ascended to the fundus uteri. From the nerve situated on the posterior surface of the vein, numerous filaments passed off towards the mesial line, as on the right side; some following the smaller veins on the posterior surface of the uterus, and others becoming intimately adherent to the peritoneum. The largest of the nerves which accompanied the uterine vein was traced as high as the part where the Fallopian tube enters the uterus; and there it divided into numerous filaments, which plunged deep into the muscular coat of the uterus along with the vein. A large fasciculated band, like a plexus of nerves, was also seen on the left side

under the peritoneum, crossing the body of the uterus; and several branches, apparently nervous, proceeding from this band, were distinctly continuous with some of the smaller branches of nerves accompanying the uterine veins. The preparation of the parts was placed in the Museum of St. George's Hospital, on the 1st of October, 1838; and several anatomists who examined it were of opinion that they were absorbents accompanying the uterine veins, and tendinous fibres spread across the posterior surface.

Dr. Lee availed himself of another opportunity which presented itself, on the 18th of December of the same year, of examining a gravid uterus in the sixth month of pregnancy, which had the spermatic, hypogastric and sacral nerves remaining connected with it; and during the last ten months, he has been diligently occupied in tracing the nerves of this uterus. He believes that he has ascertained that the principal trunks of the hypogastric nerves accompany, not the arteries of the uterus, as all anatomists have represented, but the veins; that these nerves become greatly enlarged during pregnancy; and that their branches are actually incorporated, or coalesce with the branches of the four great fasciculated bands on the anterior and posterior surface of the uterus, bearing a striking resemblance to ganglionic plexuses of nerves, and sending numerous branches to the muscular coat of the uterus.

The author gives the following description of the nerves of the gravid uterus in the sixth month, and of these fasciculated bands as displayed in the dissection.

Behind the uterus, the aortic plexus divides into two portions, to form the right and left hypogastric plexuses. These plexuses, after an intimate union with the nerves accompanying the ureters, descend to the neck of the uterus, upper part of the vagina, and contiguous parts of the bladder and rectum, where they are joined by branches from the third and fourth sacral nerves. The left hypogastric plexus, about two inches below the aortic plexus, sends off a large branch, which passes on the inside of the ureter to the superior uterine vein, where it is about to terminate in the hypogastric vein. Here the nerve suddenly expands, becomes broad and thin, and passes into a great plexus of nerves, which completely encircles the vein. This plexus, surrounding the uterine vein, is joined below by two large branches, which proceed from the hypogastric plexus nearer the vagina, and lower down, and from which branches pass on the outside of the ureter. From the upper part of this plexus, surrounding the uterine vein near its termination, three large trunks of nerves proceed upwards with the vein to the superior part of the uterus, and enlarge as they ascend. The posterior branch of these hypogastric nerves sends off in its course smaller branches, which accompany the ramifications of the uterine vein on the posterior surface of the uterus. Passing upwards beyond the junction of the spermatic with the uterine vein, and running between the peritoneum and the left posterior fasciculated band, it spreads out into a web of thin broad branches and slender nervous filaments, some of which are inserted into the peritoneum, and others follow the vein to the

fundus uteri, which they completely surround as the vein passes down into the muscular coat of the uterus.

Some of the branches of this nerve, near the fundus uteri, are distributed to the muscular coat, but these are small and few in number.

The middle and anterior branches of the hypogastric nerves adhere closely to the uterine vein as they ascend, and form around it several plexuses, which completely invest the vessel. From these plexuses branches are sent off to the anterior surface of the uterus, some of which, in an arborescent form, follow the trunk and branches of the uterine artery. These two hypogastric nerves ascend, and closely unite with the left posterior fasciculated band.

On the left side of the uterus this band arises near the mesial line, on the back of the uterus, midway between the fundus and cervix, from a mass of fibres, which adhere so firmly both to the peritoneum and muscular coat that it is difficult precisely to determine their arrangement. From these fibres the band proceeds across the uterus, in the form of a thin web, to the point where the spermatic vein is leaving the uterus. After closely uniting with the hypogastric nerves, this band proceeds outwards to the round ligament, becoming less firmly adherent to the peritoneum, where it unites with the left anterior band, and spreads out into a great web, under the peritoneum. The left posterior band is loosely attached, through its whole course, to the subjacent muscular coat by soft cellular membrane.

The spermatic nerves on the left side pass down to the ovarium with the spermatic artery, and first give off several branches to the corpus fimbriatum. A few small branches are then sent into the outer end of the ovary. The spermatic nerves afterwards leave the artery, and proceed with the veins to the uterus, where they firmly unite to the outer extremity of the left posterior band; and after the junction of this band with the prolongations of the anterior band under the round ligament, numerous small, delicate filaments, apparently nervous, are sent to the base of the ovarium.

On the right side of the uterus, the author finds that the distribution of the hypogastric and spermatic nerves does not essentially differ from that now described as seen on the left side. The form and situation of the right posterior band is, he states, much more clearly seen than on the left side, and presents the appearance of a white pearly fasciculated membrane about a quarter of an inch in breadth, proceeding from the mesial line at right angles to the hypogastric nerves, across the body of the uterus, to the round ligament, where it unites with the anterior band. Numerous branches, strikingly resembling the branches of nerves, are sent off from the upper and lower edges of this band, and from its posterior surface to the muscular coat of the uterus. An extensive and intimate union at various points is distinctly perceptible between these branches sent off from the band and the branches of the hypogastric nerves. On the anterior and upper part of the neck of the uterus, there is a great mass of reddish-coloured fibres, firmly interlaced together, resembling a ganglion of nerves, into which numerous large branches of the hy-

pogastric nerves on both sides enter, and to which they firmly adhere. From the upper part of this fibrous substance there passes up, over the whole anterior surface of the uterus, a thin band of firm white fasciculated fibres, prolongations of which extend to the round ligaments,—into which, and into the posterior band, they are continued by numerous filaments, like those of nerves. From the posterior surface of this great band, numerous branches, also apparently nervous, can be traced to a considerable depth through the muscular coat of the uterus.

The author concludes his paper with the following remark, and a short historical account of the progress of discovery on the subject of the nerves of the uterus:—

"From the form, colour and general appearance of these fasciculated bands, and the resemblance they bear to ganglionic plexuses of nerves, and from their branches actually coalescing with the hypogastric and spermatic nerves, I was induced to conclude, on first discovering them, that they were nervous plexuses, and constituted the special nervous system of the uterus. The recent examination, however, of the gravid uterus of some of the lower animals, in which I have found a structure similar to those bands in large quantity under the peritoneum, has left me in considerable doubt as to the nature of these bands, and until further investigations have been made, I shall not venture to pronounce a positive opinion respecting them."

The description of the nerves of the uterus contained in Professor Tiedemann's splendid work, the author adds, is usually referred to by anatomical writers as the most accurate and complete which has ever been given. Professor Tiedemann has represented the spermatic nerves as being distributed chiefly to the ovarium; and the hypogastric as invariably accompanying the trunk and branches of the uterine arteries, along the sides of the uterus,—dividing into smaller branches, and quickly disappearing in the muscular coat of the uterus. He has made no mention of the large nervous trunks on both sides of the uterus, which accompany the uterine veins; nor has he noticed fasciculated transverse bands on the anterior and posterior surfaces of the uterus, connected with the hypogastric and spermatic nerves.

"Observations made at the Cape of Good Hope, in the year 1838, with Bradley's Zenith Sector, for the verification of the amplitude of the Abbé de la Caille's Arc of the Meridian; by order of the Lords Commissioners of the Admiralty." By Thomas Maclear, Esq., M.A., F.R.S., &c. Communicated by Sir John Barrow, Bart., V.P.R.S., &c.

The author gives an account of the precautions taken in putting together the different parts of the zenith sector, which he received on the 9th of December, 1837, in erecting it in the central room of the Royal Observatory at the Cape of Good Hope, and in afterwards transferring it to the southern station of La Caille, in Cape Town. He then proceeds to describe La Caille's observatory, and the particular circumstances of its locality, with relation to the object in

view, namely to determine the influence of Table Mountain on the direction of the plumb-line. He next relates his progress to Klyp Fonteyn, where he arrived on the 24th of March, 1838, and describes the operations resorted to for erecting the sector at that place. He then enters into the details of observations made at different stations, and especially with comparative observations at the summit and foot of the mountain of Pequet Berg. The instrument was lastly conveyed back to Cape Town, and again examined, and the observations made with it repeated. The reduction of the observations occupies the remainder of the paper; and in conclusion, the author remarks, that although these labours have not altogether cleared up the anomaly of La Caille's arc, yet they show that great credit is due to that distinguished astronomer, who with imperfect means, and at the period in which he lived, arrived at a result, derived from sixteen stars, almost identical with that from 1139 observations on forty stars, made with a celebrated and powerful instrument.

December 19, 1839.

MAJOR SABINE, R.A., V.P., in the Chair.

Henry Drummond, Esq., was duly elected a Fellow of the Society.

A paper was read, entitled, "An account of experiments made with the view of ascertaining the possibility of obtaining a spark before the circuit of the Voltaic Battery is completed." By J. P. Gassiot, Esq.

The author of this paper adverts to the fact, of a spark invariably appearing when the circuit of the Voltaic Battery is completed; an effect which Dr. Faraday has shown can be easily produced, even with a single series. He then refers to the experiments of Mr. Children, Sir Humphry Davy, and Professor Daniell, recorded in the Philosophical Transactions; in which experiments, when more powerful and extended series were used, the spark was obtained before contact took place.

In order to ascertain, not only the fact of a spark being obtained, but also the distance through which it may be passed, the author had an instrument prepared, which he denominates a *Micrometer Electrometer*, and by which an appreciable space of one five-thousandth of an inch could be measured with great accuracy. He describes this instrument; and relates several experiments which he made with a view to test the correctness of its action. He first prepared 160, and then 320 series of the constant battery, in half-pint porcelain cells, excited with solutions of sulphate of copper and muriate of soda; but although the effects, after the contact had been completed, were exceedingly brilliant, not the slightest spark could be obtained. He was equally unsuccessful with a water battery of 150 series, each series being placed in a quart glass vessel;

and also with a water battery belonging to Professor Daniell, consisting of 1020 series; but when a Leyden battery of nine jars was introduced into the circuit of the latter, sparks passed to the extent, in one instance, of six five-thousandths of an inch.

The author mentions his having been present at the experiment of Professor Daniell, on the 16th of February, 1839, when that gentleman had 70 series of his large constant battery in action; and having been witness of the powerful effects obtained by this apparatus, he was induced to prepare 100 series of precisely the same dimensions, and similarly excited: but although this powerful apparatus was used under every advantage, and the other effects produced were in every respect in accordance with the extent of the elements employed, still no spark could be obtained until the circuit was completed; *even a single fold* of a silk handkerchief, or a piece of dry tissue paper, was sufficient to insulate the power of a battery, which, after the circuit had been once completed, fused titanium, and heated 16 feet 4 inches of No. 20 platinum wire.

The author then describes a series of experiments made with induced currents. Twelve hundred and twenty iron wires, each insulated by resin, were bent into the form of a horse-shoe. A primary wire of 115 feet and a secondary of 2268 feet, were wound round the iron wires. With this arrangement he obtained a direct spark (through the secondary current), sufficient to pierce paper, to charge a Leyden jar, &c. Several forms of apparatus employed by the author are next described, and also a series of 10,000 of Jacubone's piles. With this arrangement he charged a Leyden battery to a considerable degree of intensity, and obtained direct sparks of three-fiftieths of an inch in length. He ultimately succeeded in obtaining chemical decompositions of a solution of iodine and potassium, the iodine appearing at the end composed of the black oxide of manganese.

The Society then adjourned over the Christmas Vacation, to meet again on the 9th of January, 1840.

January 9, 1840.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treasurer, in the Chair.

John Augustus Lloyd, Esq., who, at the last Anniversary, had ceased to be a Fellow, from the non-payment of his annual contribution, was at this meeting re-admitted by ballot into the Society, agreeably to the provision of the Statutes.

James Whatman, Jun., Esq., M.A., was balloted for, and duly elected into the Society.

A paper was read, entitled, "On the construction and use of Single Achromatic Eye-Pieces, and their superiority to the double eye-piece of Huyghens." By the Rev. J. B. Reade, M.A., F.R.S.

The author observes, that experience has shown it to be impracticable to make a telescope even approach to achromatism, by employing the same object-glass with an astronomical, as with a terrestrial eye-piece: for if the focus of the blue rays from the object-glass be thrown forwards, as it must be in order to make it impinge upon the focus of the blue rays of the terrestrial eye-glass, then there will be produced a great *over-correction* for the astronomical eye-glass; and *vice versa*. Hence it appears that the application of Huyghenian eye-pieces to refracting telescopes, is incompatible with the conditions of achromatism, throughout the entire range of magnifying power; and that in reflecting telescopes they unavoidably introduce dispersion, because they are not in themselves achromatic. These defects the author proposes wholly to obviate, by substituting for the Huyghenian eye-pieces, single achromatic lenses of corresponding magnifying power; consisting of the well-known combination of the crown-lens, and its correcting flint-lens, having their adjacent surfaces cemented together; thus avoiding internal reflections, and enabling them to act as a single lens. The achromatic eye-pieces which he uses were made by Messrs. Tulley and Ross, and are of the description usually termed *single cemented triples.*

A paper was also read, entitled, "Meteorological Observations made between October, 1837, and April, 1839, at Alten in Finmarken." By Mr. S. H. Thomas, chief mining agent at the Alten Copper Works. Presented to the Royal Society by John R. Crowe, Esq., Her Britannic Majesty's Consul at Finmarken. Communicated by Major Edward Sabine, R.A., V.P.R.S.

This memoir consists of tables of daily observations of the barometer and thermometer, taken at 9 A.M., 2 P.M., and 9 P.M., with remarks on the state of the weather, at Kaafjord, in latitude 69° 58′ 3″ north, and longitude 23° 43′ 10″ east of Paris.

January 16, 1840.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treasurer, in the Chair.

A paper was read, entitled, "On Nobili's Plate of Colours; in a Letter from J. P. Gassiot, Esq., addressed to J. W. Lubbock, Esq., V.P. and Treasurer R.S." Communicated by J. W. Lubbock, Esq.

The effect produced by the late Signor Nobili, of inducing colours on a steel plate, excited the curiosity of the author, and led him to the invention of the following method of producing similar effects. Two of Professor Daniell's large constant cells were exci-

ted with the usual solutions of sulphate of copper and sulphuric acid. A highly-polished steel plate was placed in a porcelain soup-plate, and a filtered solution of acetate of lead poured upon it. A piece of card-board, out of which the required figures had been previously cut with a sharp knife, was then placed upon a steel-plate. Over the card, and resting on it, there was fixed a ring of wood, a quarter of an inch thick, and the inner circumference of which was of the same size as the figure. A convex copper-plate was made so that its outer edge might rest on the inner part of the wooden ring; and its centre placed near, but not in actual contact with the card-board. Connexion was then made by the positive electrode of the battery with the steel-plate; the negative being placed in the centre of the copper convex plate. The figure was generally obtained in from 15 to 35 seconds. If a concave, instead of a convex plate be used, the same colours are obtained as in the former experiment, but in an inverse order.

" Geographical position of the principal points of the Triangulations of the Californias and of the Mexican coasts of the Pacific, with the heights of the principal points of that part of the Cordilleras." By the Comte Vincent Piccolomini; in a letter addressed to Sir John F. W. Herschel, Bart., V.P.R.S. Communicated by Sir John Herschel.

Hauteurs des principaux points des Cordilleres, des côtes de l'Océan Pacifique du Mexique, et de la haute et basse Californie.

	Elévation en pieds français sur le niveau de la mer pacifique.		Elévation en pieds français sur le niveau de la mer pacifique.
Volcano di Orizaba	18728	Tasco	5971
Volcano di Popocatepetl..	17812	Temascaltepec	5760
Volcano di Tztlacihuatl...	15698	Guernavaia..................	5447
Rio frio	10948	Tchuacan	5398
Real del Monte	10570	Xantetelco	5030
El oro........................	8995	Cuicatlan	5028
Tlalpuhahua	8435	Oajaca	5024
Ameia........................	8247	Cuautla	4587
Naupalucan	8194	Talapa	4542
Las Vigas	7918	Acayucan	4485
Perote........................	7911	Coscomatepec	4451
Ozumba (Etat de Puebla)	7874	Huatusco	4424
Tepeyahualco..............	7702	Talostoc	4421
Ozumba (Etat de Mexico)	7620	Lautepec.....................	4019
S. Rosa	7565	Orizaba (ville)	3998
Lagunas de Chalco	7510	Real de Christo	3851
Mexico	7450	Huaitla	3336
Tepeaca	7444	Cordova	2769
Huehuetaca	7121	Dominguillo	2274
Puebla	7078	Villalé........................	1578
Tula	6613	Petapa	617
Tlacotepec	6479	Tehuantepec (Océan Pacifique.)..................	132
Zacualpan	6181		

Position géographique des principaux points de la Triangulation des Californies et des côtes de l'Océan Pacifique du Mexique par le Comte Vincent Piccolomini.

	Latitude.	Longitude calculée de Greenwich.
	° ′ ″	° ′ ″
Volianos de las Virgenes	29 91 14·35	121 46 30·82
Cap S. Lucas (Basse californie)	23 08 35·27	109 82 15·04
Monterrey (Haute californie)	36 58 17·85	121 46 53·09
Guaymas (Département de Sonora)	27 55 00·48	111 45 37·42
Matamoros (Texas)	25 59 22·07	97 54 18·76
Id. Id. Barra grande de S. Yayo	26 30 27·15	... ...
Id. Id. Barra del Rio	25 53 03·11	... ...
Bejar (Texas)	29 74 88·93	98 85 17·74
Mine d'or de S. Yago de los Cabálleros	25 13 77·04	106 67 15·87
Vulians de Tuxtla	18 47 25·91	94 07 43·11
Namampateptl (Province de Vera Cruz)	19 21 48·71	
Bahia de San Francesco (au cap los Reyex dans la haute Californie)	37 59 17·29	122 37 13·04
Port de San Blas, tour de l'église (guadalajara)	21 67 05·54	105 43 17·28
Volcanos de Colima	19 03 45·17	103 21 47·04

N.B. L'instrument employé pour déterminer les Longitudes était un Chronomètre de O. H. Bestor; pour la mesure des triangles de prémier ordre je me servis d'un théodolite de dix pouces de diamètre sortant des ateliers de Munchi, pourvu de quatre verniers et donnant 10″. Les élévations du sol furent déterminées par des observations barométriques faites avec soin, souvent répetées et déduites par le moyen d'observations correspondants; elles furent calculées d'après la méthode d'Oltmanns et vérifieés par celles du Baron Zach. —V.P.

"Report on the co-operation of the Russian and German observers, in a system of simultaneous Magnetical Observations." By the Rev. H. Lloyd, F.R.S., in a letter addressed to Sir John F. W. Herschel, Bart., V.P.R.S. Communicated by Sir John Herschel.

"On Magnetical Observations in Germany, Norway, and Russia." By Major Sabine, R.A., V.P.R.S., in a letter to Baron von Humboldt, For. Mem. R.S., dated Oct. 24th, 1839.

These letters relate to communications which Professor Lloyd and Major Sabine have had, conformably to a resolution of the Council of the Royal Society, with the scientific authorities at Göttingen, Berlin, and St. Petersburg, respecting the organization of a simultaneous system of magnetical observations. It appears, from these letters, that the system proposed by the Royal Society is viewed with general interest and approbation; and nineteen stations are enumerated at which there is reason to expect that magnetical observatories, acting in concert, on that system, will be established.

January 23, 1840.

Sir JOHN BARROW, Bart., V.P., in the Chair.

John Pye Smith, D.D. was balloted for, and duly elected into the Society.

A paper was read, entitled "On the structure of Normal and Adventitious Bone." By Alfred Smee, Esq., communicated by P. M. Roget, M.D. Sec. R.S.

On examining, by means of a microscope, very thin sections of bone, prepared in a peculiar manner, the author observed a number of small, irregularly-shaped, oblong corpuscles, arranged in circular layers round the canals of Havers, and also rows of similar bodies distributed around both the external and the internal margins of the bone. Each corpuscle is connected by numerous filaments, passing in all directions with the Haversian canals and the margins of the bone, and also with the adjacent corpuscles. He finds that the canals of Havers are vascular tubes containing blood. The corpuscles themselves are hollow, and their cavities occasionally communicate with those of the canals; their length is equal to about two or three diameters of the globules of the blood. They exist in cartilaginous as well as osseous structures, and are found in every instance of adventitious bone, such as callus after fracture, morbid ossific growths either from bone or from other tissues; and the author has also ascertained their presence in the bony and cartilaginous structures of inferior animals, such as birds and fishes. Measurements relating to these corpuscles, by Mr. Bowerbank, are subjoined, from which it appears that their diameters vary from about the 10,000th to the 4000th, and their lengths from the 2300th to the 1400th part of an inch.

"An attempt to establish a new and general Notation, applicable to the doctrine of Life Contingencies." By Peter Hardy, Esq., F.R.S.

After premising a short account of the labours of preceding writers, with reference to a system of notation in the mathematical consideration of life contingencies, the author enters at length into an exposition of the system of symbols which he has himself devised, together with the applications which they admit of in a variety of cases.

January 30, 1840.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treasurer, in the Chair.

James Annesley, Esq., was balloted for, and duly elected into the Society.

A paper was read, entitled "Observations on Single Vision with

two Eyes." By T. Wharton Jones, Esq. Communicated by Richard Owen, Esq., F.R.S.

The author animadverts on the doctrine which Mr. Wheatstone, in his paper on the Physiology of Binocular vision, published in the Philosophical Transactions for 1838, p. 371, has advanced, in opposition to the received theory of single vision being dependent on the images of objects falling on corresponding points of the two retinæ. He maintains that, under these circumstances, the two impressions are not perceived by the mind at the same instant of time, but sometimes the one and sometimes the other. If one impression be much stronger than the other, the former predominates over, or even excludes the other; but still the appearance resulting from the predominating image is nevertheless in some manner influenced by that which is not perceived. He supposes that there are compartments of the two retinæ, having certain limits, of which any one point or papilla of the one corresponds with any one point of the other, so that impressions on them are not perceived separately; and considers that this hypothesis, combined with the principle above stated, is required, in order to explain the phenomena in question.

February 6, 1840.

JOHN WILLIAM LUBBOCK, Esq., V.P. and Treasurer, in the Chair.

John Parkinson, Esq. and the Rev. Charles Pritchard, M.A. were balloted for, and declared duly elected into the Society.

A paper was read, entitled "Observations on the Blood-corpuscles of certain species of the Genus Cervus." By George Gulliver, Esq., F.R.S., Assistant Surgeon to the Royal Regiment of Horse Guards.

The author has found that the blood of the Muntjac*, the Porcine†, and the Mexican Deer‡, contains, together with corpuscles of the ordinary circular form, a still larger number of particles of less regular shape; some curved and gibbous in the middle, and acutely pointed at the ends, with a concave and convex margin, like a crescent; others approaching more nearly to segments of a circle; some shaped like a comma, being obtuse at one end and terminated by a pointed curve at the other; others having an acute projection of the convex part, so as to constitute a triangular, or even quadrangular outline; some having the figure of the head of a lance; while a few presented a double or sigmoid flexure, as if they had been twisted half round at the middle. Like the ordinary blood-discs, these peculiar corpuscles are deprived of their colouring matter by water; but with only a small quantity of water they quickly swell out, and

* *Cervus Reevesii.* † *C. Porcinus.* ‡ *C. Mexicanus.*

assume an oval or circular figure, forming long bead-like strings by the approximation of their edges. In saline solutions they become rather smaller, but preserve their figure tolerably well.

In an appendix, the author gives an account of his observations of the blood-corpuscles of a new species of Deer inhabiting the mountains of Persia, of which a specimen has been lately received by the Zoological Society. Many of these corpuscles presented the singular forms above described.

A paper was also read, entitled "Meteorological Register kept at Port Arthur, Van Diemen's Land, during the year 1838." By Deputy-Assistant Commissary-General Lempriere, in south latitude 43° 9′ 6″, and east longitude 147° 51′ 33″. Communicated by Captain Beaufort, R.N., F.R.S.

The height of the instrument above the level of the sea till the 21st of August was 57 feet, 7 inches; and during the remainder of the year 3 feet.

A paper was also in part read, entitled "Experimental Researches in Electricity, 16th Series." By Michael Faraday, Esq., D.C.L., F.R.S., &c.

February 13, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Martin Barry, M.D. and Joseph Phillimore, LL.D., were balloted for, and duly elected into the Society.

The reading of a paper, entitled "Experimental Researches in Electricity, 16th Series." By Michael Faraday, Esq., D.C.L., F.R.S., &c., was resumed and concluded. On the source of power in the Voltaic pile.

The determination of the real source of electrical power in galvanic combinations has become, in the present state of our knowledge of electricity, a question of considerable importance, and one which must have great influence on the future progress of that science. The various opinions which have been entertained by philosophers on this subject may be classed generally under two heads; namely, those which assign as the origin of voltaic power the simple contact of dissimilar substances, and more especially of different metals; and secondly, those which ascribe this force to the exertion of chemical affinities. The first, or the theory of contact, was devised by Volta, the great discoverer of the Voltaic pile; and adopted, since it was promulgated by him, by a host of subsequent philosophers, among the most celebrated of whom may be ranked Pfaff, Marianini, Fichner, Zamboni, Matteucci, Karsten, Bruchardat, and also Davy; all of them bright stars in the exalted galaxy of science.

The theory of chemical action was first advanced by Fabroni, Wollaston, and Parret; and has been since farther developed by Oersted, Becquerel, De la Rive, Ritchie, Pouillet, Schonbein, and others. The author of the present paper, having examined this question by the evidence afforded by the results of definite electro-chemical action, soon acquired the conviction of the truth of the latter of these theories, and has expressed this opinion in his paper, published in the Philosophical Transactions for 1834.

The author, after stating the fundamental doctrine laid down by Volta, proceeds to give an account of various modifications in the theory introduced by subsequent philosophers; and also of different variations in the views of those who, in the main, have adopted the chemical theory. Being desirous of collecting further and more decisive evidences on this important subject, he engaged in the series of experimental researches which are detailed in the present memoir.

It is assumed, he observes, by the advocates of the contact theory, that although the metals exert powerful electromotive forces at their points of mutual contact, yet in every complete metallic circuit, whatever be the order or arrangement of the metals which compose it, these forces are so exactly balanced as to prevent the existence of any current; but that, on the other hand, fluid conductors, or electrolytes, either exert no electromotive force at their place of contact with the metals, or, if they do exert such a power, the forces called into play in the complete circuit are not subject to the same law of compensation as obtains with circuits wholly composed of metallic bodies. The author successfully combats this doctrine, by bringing forward a great number of instances, where certain fluids, which have no chemical action on the metals with which they were associated in the circuit, are in themselves such good conductors of electricity, as to render evident any current which could have arisen from the contact of the metals, either with each other or with the fluid; the evidence of their possessing this conducting power being their capability of transmitting a feeble thermo-electric current from a pair of plates of antimony and bismuth. The following he found to be fluids possessing this property in a high degree; namely, a solution of sulphuret of potassium, yellow anhydrous nitrous acid mixed with nearly an equal volume of water, very strong red nitric acid, and a mixture of one volume of strong acid with two volumes of water. By employing the solution of sulphuret of potassium as an electrolyte of good conducting power, but chemically inactive with reference to either iron or potassium; and associating it with these metals in a circuit, formed by two test-glasses containing the solution, into one of which was immersed a plate of platina and a plate of iron, and in the other two plates of platina; and the circuit being completed by wires of the same metals respectively, joining the iron-plate in the first glass with one of the platina-plates in the second, while the other two platina-plates were united by platina wires, interrupted at one part by a short iron wire which joined their ends;—it was found by the test of an interposed galva-

nometer, that, as no chemical action took place, so no electric current was produced; yet the apparatus thus arranged could transmit a very feeble thermo-electric current, excited by slightly raising the temperature of the wires at either of their points of contact. Hence, the inference may be drawn, that the contact of iron and platinum is of itself productive of no electromotive force. On the other hand, the author shows, that the interposition in the circuit of the smallest quantity of an electrolyte, which acts chemically on either of the metals, the arrangement remaining in all other respects the same, is immediately attended with the circulation of an electrical current far more powerful than the thermo-electric current above-mentioned. A great number of combinations of other metals were successively tried in various ways, and they uniformly gave the same results as that of iron and platina. Similar experiments were then made with various metallic compounds, and also with other chemical agents; and in all cases the same general fact was observed; namely, that when no chemical action took place, no electrical current was excited; thus furnishing, in the opinion of the author, unanswerable arguments against the truth of the theory of contact. The only way in which it is possible to explain these phenomena on that theory, would be by assuming, that the same law of compensation as to electro-motive power is observed by the sulphuret of potassium, and the other fluids of corresponding properties, as obtains in the case of the metals, although that law does not apply to the generality of chemical agents; and in like manner, different assumptions must be made in order to suit the result in each particular combination, and this without any definite relation to the chemical character of the substances themselves; assumptions, which no ingenuity could ever render consistent with one another. At the conclusion of the paper, the author describes some remarkable alternations in the phenomena which occur, when pieces of copper and silver, or two pieces of copper, or two of silver, form a circle with the yellow sulphuretted solution; and which lead to the same conclusion as the former experiments. If the metals be copper and silver, the copper is at first positive, and the silver remains untarnished; in a short time the action ceases, and the silver becomes positive, at the same time combining with sulphur, and becoming coated with sulphuret of silver; in the course of a few minutes, the copper again becomes positive; and thus the action changes from one side to the other in succession, and is accompanied by a corresponding alternation of the electric current.

February 20, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

John Caldecott, Esq., was balloted for, and duly elected into the Society.

A paper was read, entitled "On the Wet Summer of 1839." By Luke Howard, Esq. F.R.S. &c.

The observations of the author were made at Ackworth, in Yorkshire; and the following are his results with regard to the mean temperature and the depth of rain, in each month, during 1839.

	Mean Temp. °	Rain. in inches.		Mean Temp. °	Rain. in inches.
Jan.	37·04	1·13	July	59·30	5·13
Feb.	39·64	2·14	Aug.	58·09	2·94
March	39·08	3·21	Sept.	54·49	3·43
April	44·09	0·58	Oct.	48·39	3·40
May	49·94	0·38	Nov.	43·14	4·54
June	56·35	4·89	Dec.	37·29	1·85

Mean temperature of the year 47·24°.

Total depth of rain in 1839, 33·62 inches.

He states that the climatic mean temperature of the place is about 47°, and the mean annual depth of rain about 26 inches. The excess of rain during the year 1839 was therefore very great.

The author describes the effect of the hurricane of the 7th of January, and follows the changes of the weather during the remainder of the year.

A paper was also in part read, entitled "On the chemical Action of the Rays of the Solar Spectrum on preparations of Silver and other substances, both metallic and non-metallic, and on some photographic processes." By Sir John F. W. Herschel, Bart. V.P.R.S. &c.

The President informed the Meeting that the Council had voted the following Address of Congratulation to Her Majesty, the Queen, on the occasion of Her marriage, and that he had presented it at the Levee yesterday.

"*To the Queen's Most Excellent Majesty.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to approach your sacred person, and to offer most humbly to Your Majesty our sincere and heartfelt congratulations on the present joyful occasion of the marriage of Your Majesty with His Royal Highness Prince Albert of Saxe-Coburg and Gotha; an event, which, in unison with all loyal subjects throughout Your Majesty's dominions, we cordially hail as the auspicious omen of lasting happiness to Your Majesty, and of permanent blessings to the British Empire. We venture to hope, that, amidst the universal felicitations of a free, affectionate, and grateful people, Your Majesty will condescend favourably to receive this tribute of the deep respect and devoted attachment of the Members of our Society; a Society which, under the fostering protection of the successive Sovereigns of these realms during a period of

nearly two centuries, has exerted itself to extend the boundaries of scientific knowledge, and of those arts which augment the power and ameliorate the condition of the human race; objects to which Your Majesty, following the steps of Your Illustrious Predecessors, has already been graciously pleased to extend Your Royal patronage and encouragement.

"That Your Majesty's reign may be long, happy, and glorious, and that it may be especially distinguished in the annals of history as the pacific era in which the greatest advances were made in Science, Literature, and the useful Arts, and in which the deep foundations of prosperity to this great empire, and of improvement in the condition of mankind, were consolidated, is the earnest wish and fervent prayer of the President, Council, and Fellows of the Royal Society of London."

The President also stated to the Meeting, that the Council had adopted the following Address of Congratulation to His Royal Highness Prince Albert, of Saxe Coburg and Gotha.

"*To His Royal Highness Prince Albert of Saxe-Coburg and Gotha.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave humbly to present to Your Royal Highness our sincere and most cordial congratulations on the happy occasion of Your Royal Highness's marriage with Her Majesty, the Queen of these realms; an event which, from the known virtues and high endowments of Your Royal Highness, we confidently anticipate will prove the abundant source of domestic happiness to Her Majesty and to Your Royal Highness, as well as of important advantage to the interests of this great and united empire.

"The Royal Society, more especially, has reason to rejoice in beholding the exalted station now occupied by Your Royal Highness, filled by an enlightened and liberal Prince early imbued with the principles of virtue and religion, and whose mind, already expanded, invigorated, and refined by the assiduous cultivation of literature, science, and philosophy, is qualified justly to appreciate the importance to mankind of those pursuits to which the Royal Society has directed its constant attention.

"That Your Royal Highness may, under the blessing of Providence, long enjoy every happiness, is the ardent wish and prayer of Your Royal Highness's humble and devoted servants, the President, Council, and Fellows of the Royal Society of London."

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1840. No. 42.

February 27, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

William Jory Henwood, Esq., was balloted for, and duly elected into the Society.

The reading of a paper entitled, "On the Chemical Action of the Rays of the Solar Spectrum on Preparations of Silver and other Substances, both metallic and non-metallic; and on some Photographic processes;" by Sir John F. W. Herschel, Bart., V.P.R.S., &c., was resumed but not concluded.

The President stated to the Meeting, that, accompanied by the Treasurer, Secretary, and other Members of the Council, he had, on Tuesday last, presented the Address to His Royal Highness Prince Albert, to which His Royal Highness returned the following gracious answer:

"It has been the source of great pleasure to me that my arrival in this country should have been hailed with such flattering demonstrations of sincere affection. Amongst the many that have reached me, none have given me more satisfaction than that which I have just received from the Council of the Royal Society."

March 5, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Captain John Theophilus Boileau was balloted for, and duly elected into the Society.

The reading of a paper entitled, "On the Chemical Action of the Rays of the Solar Spectrum on Preparations of Silver and other Substances, both metallic and non-metallic; and on some Photographic Processes;" by Sir John F. W. Herschel, Bart., V.P.R.S., &c., was resumed and concluded.

The object which the author has in view in this memoir is to place

on record a number of insulated facts and observations respecting the relations both of white light, and of the differently refrangible rays, to various chemical agents which have offered themselves to his notice in the course of his photographic experiments, suggested by the announcement of M. Daguerre's discovery. After recapitulating the heads of his paper on this subject, which was read to the Society on the 14th of March, 1839, he remarks, that one of the most important branches of the inquiry, in point of practical utility, is into the best means of obtaining the exact reproduction of indefinitely multiplied facsimiles of an original photograph, by which alone the publication of originals may be accomplished; and for which purpose the use of paper, or other similar materials, appears to be essentially requisite. In order to avoid circumlocution, the author employs the terms *positive* and *negative* to express, respectively, pictures in which the lights and shades are the same as in nature, or as in the original model, and in which they are the opposite; that is, light representing shade; and shade, light. The terms *direct* and *reverse* are also used to express pictures in which objects appear, as regards right and left, the same as in the original, and the contrary. In respect to photographic publication, the employment of a camera picture avoids the difficulty of a double transfer, which has been found to be a great obstacle to success in the photographic copying of engravings or drawings.

The principal objects of inquiry to which the author has directed his attention in the present paper, are the following. First, the means of fixing photographs; the comparative merits of different chemical agents for effecting which, such as hyposulphite of soda, hydriodite of potash, ferrocyanate of potash, &c., he discusses at some length; and he notices some remarkable properties, in this respect, of a peculiar agent which he has discovered.

2. The means of taking photographic copies and transfers. The author lays great stress on the necessity, for this purpose, of preserving, during the operation, the closest contact of the photographic paper used with the original to be copied.

3. The preparation of photographic paper. Various experiments are detailed, made with the view of discovering modes of increasing the sensitiveness of the paper to the action of light; and particularly of those combinations of chemical substances which, applied either in succession or in combination, prepare it for that action. The operation of the oxide of lead in its saline combinations as a mordent is studied; and the influence which the particular kind of paper used has on the result, is also examined, and various practical rules are deduced from these experiments. The author describes a method of precipitating on glass a coating possessing photographic properties, and thereby of accomplishing a new and curious extension of the art of photography. He observes, that this method of coating glass with films of precipitated argentine, or other compounds, affords the only effectual means of studying their habitudes on exposure to light, and of estimating their degree of sensibility, and other particulars of their deportment under the influence of reagents. After

stating the result of his trials with the iodide, chloride, and bromide of silver, he suggests that trials should be made with the fluoride, from which, if it be found to be decomposed by light, the corrosion of the glass, and consequently an etching, might possibly be obtained, by the liberation of fluorine.

As it is known that light reduces the salts of gold and of platinum, as well as those of silver, the author was induced to make many experiments on the chlorides of these metals, in reference to the objects of photography; the details of which experiments are given. A remarkable property of hydriodic salts, applied, under certain circumstances, to exalt the deoxidating action of light, and even to call into evidence that action, when it did not before exist, or else was masked, is then described.

4. The chemical analysis of the solar spectrum forms the subject of the next section of his paper. It has long been known that rays of different colours and refrangibilities exert very different degrees of energy in effecting chemical changes; and that those occupying the violet end of the spectrum possess the greatest deoxidating powers. But the author finds that these chemical energies are distributed throughout the whole of the spectrum; that they are not a mere function of the refrangibility, but stand in relation to physical qualities of another kind, both of the ray and of the analysing medium; and that this relation is by no means the same as the one which determines the absorptive action of the medium on the colorific rays. His experiments also show that there is a third set of relations concerned in this action, and most materially influencing both the amount and the character of the chemical action on each point of the spectrum; namely, those depending on the physical qualities of the substance on which the rays are received, and whose changes indicate and measure their action.

The author endeavoured to detect the existence of inactive spaces in the chemical spectrum, analogous to the dark lines in the luminous one; but without any marked success. The attempt, however, revealed several curious facts. The maximum of action on the most ordinary description of photographic paper, namely, that prepared with common salt, was found to be, not beyond the violet, but about the confines of the blue and green, near the situation of the ray F in Fraunhofer's scale: and the visible termination of the violet rays nearly bisected the photographic image impressed on the paper: in the visible violet rays there occurred a sort of minimum of action, about one-third of the distance from Fraunhofer's ray H, towards G: the whole of the red, up to about Fraunhofer's line C appears to be inactive; and lastly, the orange-red rays communicate to the paper a brick-red tint passing into green and dark blue. Hence are deduced, first, the absolute necessity of perfect achromaticity in the object-glass of a photographic camera; and secondly, the possibility of the future production of naturally coloured photographs.

5. The extension of the *visible* prismatic spectrum beyond the space ordinarily assigned to it, is stated as one of the results of these researches; the author having discovered that beyond the extreme

violet rays there exist luminous rays affecting the eyes with a sensation, not of violet, or of any other of the recognised prismatic hues, but of a colour which may be called *lavender-grey*, and exerting a powerful deoxidating action.

6. Chemical properties of the red end of the spectrum. The rays occupying this part of the spectrum were found to exert an action of an opposite nature to that of the blue, violet, and lavender rays. When the red rays act on prepared paper in conjunction with the diffused light of the sky, the discolorating influence of the latter is suspended, and the paper remains white; but if the paper has been already discoloured by ordinary light, the red rays change its actual colour to a bright red.

7. The combined action of rays of different degrees of refrangibility is next investigated; and the author inquires more particularly into the effects of the combined action of a red ray with any other single ray in the spectrum; whether any, and what differences exist between the joint, and the successive action of rays of any two different and definite refrangibilities; and whether this action be capable, or not, of producing effects, which neither of them, acting alone, would be competent to produce. The result was that, although the previous action of the less refrangible rays does not appear to modify the subsequent effects produced by the more refrangible; yet the converse of this proposition does not obtain, and the simultaneous action of both produces photographic effects very different from those which either of them, acting separately, are capable of producing.

8. In the next section, the chemical action of the solar spectrum is traced much beyond the extreme red rays, and the red rays themselves are shown to exercise, under certain circumstances, a blackening or deoxidating power.

9. The author then enters into a speculation suggested by some indications which seem to have been afforded of an absorptive action in the sun's atmosphere; of a difference in the chemical agencies of those rays which issue from the central parts of his disc, and those which, emanating from its borders, have undergone the absorptive action of a much greater depth of his atmosphere; and consequently of the existence of an absorptive solar atmosphere extending beyond the luminous one.

10. An account is next given of the effect of the spectrum on certain vegetable colours, as determined by a series of experiments, which the author has commenced, but in which the unfavourable state of the weather has, as yet, prevented him from making much progress.

11. The whitening power of the several rays of the spectrum under the influence of hydriodic salts, on paper variously prepared and previously darkened by the action of solar light. The singular property belonging to the hydriodate of potash of rendering darkened photographic paper susceptible of being whitened by further exposure to light is here analysed, and shown to afford a series of new relations among the different parts of the spectrum, with respect to their chemical actions.

12. The Analysis of the Chemical Rays of the Spectrum by absorbent media, which forms the subject of the next section, opens a singularly wide field of inquiry; and the author describes a variety of remarkable phenomena which have presented themselves in the course of his experiments on this subject. They prove that the photographic properties of coloured media do not conform to their colorific character; the laws of their absorptive action as exerted on the chemical, being different and independent of those on the luminous rays: instances are given of the absence of any darkening effect in green and other rays of the more refrangible kind, which yet produce considerable illumination on the paper that receives them.

13. The exalting and depressing power exercised by certain media, under peculiar circumstances of solar light, on the intensity of its chemical action. This branch of the inquiry was suggested by the fact, noticed by the author in his former communication, that the darkening power of the solar rays was considerably increased by the interposition of a plate of glass in close contact with the photographic paper. The influence of various other media, superposed on prepared paper, was ascertained by experiment, and the results are recorded in a tabular form.

14. The paper concludes with the description of an *Actinograph*, or self-registering Photometer for meteorological purposes: its objects being to obtain a permanent and self-comparable register and measure, first, of the momentary amount of general illumination in the visible hemisphere, which constitutes day-light; and secondly, of the intensity, duration, and interruption of actual sunshine, or, when the sun is not visible, of that point in the clouded sky behind which the sun is situated.

In a postscript, dated March 3rd, 1840, the author states that he has discovered a process by which the calorific rays in the solar spectrum are made to affect a surface properly prepared for that purpose, so as to form what may be called a *thermograph* of the spectrum; in which the intensity of the thermic ray of any given refrangibility is indicated by the degree of whiteness produced on a black ground, by the action of the ray at the points where it is received at that surface, the most remarkable result of which is the insulation of *heat-spots* or thermic images of the sun quite apart from the great body of the thermic spectrum. Thus the whole extent over which prismatic dispersion scatters the sun's rays, including the calorific effect of the least, and the chemical agency of the most refrangible, is considerably more than twice as great as the Newtonian coloured spectrum.

In a second note, communicated March 12, 1840, the author describes his process for rendering visible the thermic spectrum, which consists in smoking one side of very thin white paper till it is completely blackened, exposing the white surface to the spectrum and washing it over with alcohol. The thermic rays, by drying the points on which they impinge more rapidly than the rest of the surface, trace out their extent and the law of their distribution by a whiteness so induced on the general blackness which the whole sur-

face acquires by the absorption of the liquid into the pores of the paper. He also explains a method by which the impression thus made, and which is only transient, can be rendered permanent.

This method of observation is then applied to the further examination of various points connected with the distribution of the thermic rays, the transcalescence of particular media, the polarization of radiant heat (which is easily rendered sensible by this method), &c. The reality of more or less insulated spots of heat distributed at very nearly equal intervals along the axis of the spectrum (and of which the origin is *probably* to be sought in the flint glass prism used—but *possibly* in atmospheric absorption) is established. Of these spots, two of an oval form, are situated, the one nearly at, and the other some distance beyond the extreme red end of the spectrum, and are less distinctly insulated; two, perfectly round and well-insulated, at greater distances in the same direction; and one, very feeble and less satisfactorily made out, at no less a distance beyond the extreme red than 422 parts of a scale in which the whole extent of the Newtonian coloured spectrum occupies 539.

A paper was also read entitled, "Remarks on the Theory of the Dispersion of Light, as connected with Polarization;" by the Rev. Baden Powell, M.A., F.R.S., and Savilian Professor of Geometry, Oxford.

Since the publication of a former paper on the subject referred to, the author has been led to review the subject in connexion with the valuable illustrations given by Mr. Lubbock of the views of Fresnel; and points out, in the present supplement, in what manner the conclusions in that paper will be affected by these considerations.

A paper was also read, entitled, "Further Particulars of the Fall of the Cold Bokkeveld Meteorite;" by Thomas Maclear, Esq., F.R.S., in a letter to Sir John F. W. Herschel, Bart., K.H., V.P.R.S., &c. communicated by Sir John Herschel.

This communication, which is supplementary to the one already made to the Society by Mr. Maclear, contains reports, supported by affidavits, of the circumstances attending the fall of a meteoric mass in a valley near the Cape of Good Hope. The attention of the witnesses had been excited by a loud explosion which took place in the air, previous to the descent of the aerolite, and which was attended by a blue stream of smoke, extending from north to west. Some of the fragments which had been seen to fall, and which had penetrated into the earth, were picked up by the witnesses. One of them falling on grass caused it to smoke; and was too hot to admit of being touched. The mass which was sent to England by H.M.S. Scout, weighed, when first picked up, four pounds. The paper is accompanied by a map of the district, showing the course of the aerolite.

A paper was also read, entitled, "An account of the Shooting Stars of 1095 and 1243;" by Sir Francis Palgrave, K.H., F.R.S., &c.

The author gives citations from several chronicles of the middle ages, descriptive of the remarkable appearance of shooting stars which occurred on the 4th of April, 1095, on the testimony of independent witnesses both in France and England. One of them describes them as "falling like a shower of rain from heaven upon the earth:" and in another case, a bystander, having noted the spot where the aerolite fell, "cast water upon it, which was raised in steam, with a great noise of boiling." The Chronicle of Rheims describes the appearance as if all the stars in heaven were driven, like dust, before the wind. A distinct account of the shooting stars of July 26th, 1293, is given by Matthew Paris.

March 12, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

A paper was read, entitled "On certain variations of the mean height of the Barometer, mean temperature and depth of Rain, connected with the Lunar Phases, in the cycle of years from 1815 to 1823." By Luke Howard, Esq., F.R.S.

The table given in this paper contains the results of calculations relating to the objects specified in the title; cast into periods of six, seven, or eight days, so as to bring the day of the lunar phase belonging to it in the middle of the time. The observations were all made in the neighbourhood of London. It appears from them that in the period of the last quarter of the moon the barometer is highest, the temperature a little above the mean, and the depth of rain the smallest. In the period of the new moon, both the barometer and temperature are considerably depressed, and the rain increased in quantity. The influence of the first quarter shows itself by the further depression of the barometer; but the temperature rises almost to the point from which it had fallen, and the rain still increases, but not in an equal ratio. Lastly, the full moon again reduces the temperature; while the barometer attains its maximum mean height, and the quantity of rain is the greatest. Thus it appears, that during this lunar cycle, the approach of the last quarter is the signal for the clearing up of the air, and the return of sunshine.

A paper was also read, entitled "On the theory of the dark bands formed in the solar spectrum from partial interception by transparent plates." By the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

This paper contains the mathematical investigation of the phenomena of peculiar dark bands crossing the prismatic spectrum, when half the pupil of the eye, looking through the prism, is covered by a thin plate of any transparent substance, the edge being turned from the violet towards the red end of the spectrum; and which

were first noticed by Mr. Fox Talbot, and were ascribed by Sir David Brewster to a new property of light, consisting of a peculiar kind of polarity.

The author shows, that on the undulatory theory, in all cases, a difference of retardation between the two halves of each primary pencil throughout the spectrum may give bands within certain limits; and that it affords a complete explanation of the phenomena in question.

March 19, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

A paper was read, entitled "Contributions to Terrestrial Magnetism." By Major Edward Sabine, R.A., V.P.R.S.

An increased activity has recently been given to researches in terrestrial magnetism, with the definite object of obtaining correct maps of the magnetic phenomena, corresponding to the present epoch, over the whole surface of the globe. To aid these researches, and to facilitate the comparison of the general theory of M. Gauss with the facts of observation, maps have been constructed of the magnetical lines, both as computed by the theory, and as derived from observations already obtained. The theoretical and actual lines of the declination and intensity have thus been represented in maps recently published in Germany and England, as have also the lines of the inclination computed by theory; but the corresponding map or the latter element derived from observations is yet wanting. The object of the present communication is to supply this desideratum, as far as regards the portion of the globe contained between the parallels of 55° N. and 55° S., and the meridians of 20° E. and 80° W.; comprising the Atlantic ocean, and the adjacent coasts of the continents on either side.

The observations chiefly employed for this purpose are two series *made at sea*; one by Mr. Dunlop of the Paramatta observatory, in a voyage from England to New South Wales, in 1831; the other by Lieut. Sulivan of the Royal Navy, in a voyage from England to the Falkland Islands, and back, in 1838 and 1839. The observation of the magnetic dip at sea, which was commonly practised by the distinguished navigators of the last century, was unfortunately not resumed when the interest in such researches was revived on the restoration of peace: but it is by such observations only that the lines of inclination can be independently traced over those large portions of the globe which are covered by the ocean. The difficulties which attend the observation, occasioned by the motion and the iron of a ship, require the adoption of several precautions, which it is particularly desirable at this time to make generally known. The series of Messrs. Dunlop and Sulivan are discussed in this view; and the

value of results obtained under circumstances of due precaution is pointed out by their success.

The position of the lines on the land portion of the map is derived from 120 determinations in various parts of Europe, Africa, and America, between the years 1834 and 1839, of which about the half are now first communicated.

The series of Messrs. Dunlop and Sulivan contain also observations of the magnetic intensity made at sea; Mr. Dunlop's by the method of horizontal vibrations, and Lieut. Sulivan's by the instrument and method devised by Mr. Fox. The degree of precision which may be obtained by experiments thus conducted, is shown by the comparison of these observations with each other, and with the isodynamic lines previously derived from observations made on land.

The first section of this paper concludes with discussions on the relative positions of the lines of least intensity and of no dip, and of the secular change which the latter line has undergone in the ten years preceding 1837.

In the second section, the observations of Mr. Dunlop are combined with recent observations on the coasts of Australia, by Captains Fitz Roy, Bethune, and Wickham, of the Royal Navy, to furnish a first approximation to the position and direction of the isodynamic lines over that portion of the Indian ocean which is comprised between the meridian of the Cape of Good Hope and New South Wales.

A paper was also in part read, entitled "Experimental Researches in Electricity, seventeenth series." By Michael Faraday, Esq. D.C.L., F.R.S., &c., On the source of power in the Voltaic Pile.

March 26, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

The reading of a paper, entitled "Researches in Electricity, Seventeenth Series: on the source of power in the Voltaic Pile." By Michael Faraday, Esq., D.C.L., F.R.S., &c., was resumed and concluded.

In this series, the author continues his experimental investigation of the origin of electric force in the voltaic pile. Having found abundant reason, in the experiments already described, to believe that the electricity of the pile has its origin in the chemical force of the acting bodies, he proceeds to examine how the circumstances which can affect the affinity of substances for each other, influence their power of roducing electric currents. First, with relation to *heat*:—circuits were made of a single metal and a single fluid, and these were examined with a view to ascertain whether, by applying

heat at one of the junctions, only thermo-currents can be produced. Some peculiar effects of heat are noticed and explained; and several very necessary precautions in conducting these experiments are pointed out; and it is found, when these are taken, that heat has a decided and distinct effect over the chemical affinities of the parts of a circuit subjected to its power, and a corresponding influence on the electric current produced. This proceeds to such an extent, that, in some cases, either of two metals can be made positive or negative with respect to the other in the same fluid, solely by virtue of this power of heat.

The effect of *dilution* is then examined. For this purpose, only one metal and one fluid are used in a circuit; but the fluid is rendered more dilute at one point of contact than at the other. It was ascertained that such dilution produces little or no effect with metals which are not acted on by the electrolyte employed; and the precautions requisite as to other points are then stated. But when these are observed, still dilution is found to have a most powerful influence on the results; and, as the author believes, solely on account of its influence on the active chemical affinity. Thus copper in dilute nitric acid is positive with respect to copper in strong nitric acid; and the same is the case with lead, silver, and other metals. It is not that the piece in the weakest acid is always positive with respect to that in the stronger acid; for, in the first place, some very curious cases are given, in which a piece of metal in acid of a certain strength is *positive* with respect to a piece of the same metal in acid, either stronger or weaker; and, in the next place, other cases are stated in which the piece in the medium acid is *negative* with respect to the other piece in either stronger or weaker acid. The effect of dilution in nitric acid is such, that when certain different metals are compared together, either can, at pleasure, be made positive or negative with respect to the other; thus, of the five metals, silver, copper, iron, lead, and tin, any one of them can be made either positive or negative with respect to any other; with the sole exception of silver, which is always positive with respect to copper. The inconsistency of these results with any theory of contact electromotive force is then strongly insisted on by the author.

The next division of the paper treats of the order of the metallic elements of voltaic circuits when different electrolytes are used. It is usual to say, that metals are positive or negative with respect to each other in a certain order; but Davy, and afterwards De la Rive, showed that, in certain cases, this order is inverted. The author, by using ten metals, and seven different exciting electrolytic solutions, shows that in no two solutions is the order the same; but that changes of the most extreme kind occur in exact conformity with the changes in chemical action, which the use of the different solutions occasions.

The next division of the paper considers the very numerous cases in which voltaic circuits, often such as are able to effect decomposition, are produced without any metallic contact, and by virtue of

chemical action alone; contrasting them with the numerous cases given in the previous series, where contact *without* chemical action, whether it be the contact of metal with metal, or with chemically inactive electrolytes, can produce no voltaic current.

The author then considers the sufficiency of chemical action to account for all the phenomena of the pile. He shows that chemical action does actually evolve electricity; that according as chemical action diminishes or ceases, so the electrical current diminishes or ceases also; that where the chemical action changes from side to side, the direction of the current likewise changes with it; that where no chemical action occurs, no current is produced, but that a current occurs the moment chemical action commences; and that when the chemical action which has, or could have produced a current, is, as it were, reversed or undone, the current is reversed or undone likewise; that is, it occurs in the opposite direction, in exact correspondence with the direction taken by the transferred anions and cathions. The accordance of the chemical theory of excitation with these phenomena is considered by the author as of the strictest kind.

The phenomena of thermo-electricity are considered by some philosophers as affording proofs of the efficacy of mere metallic contact in exciting an electric current. The author proceeds, therefore, to examine these phenomena in relation to such an action, and arrives at the conclusion, that they, in fact, disprove the existence of such a power. In thermo-electricity, the metals have an order which is so different from that belonging to them in any electrolyte, that it appears impossible to consider their succession, in any case, as due to any mutual effect of the metals on each other, common to both modes of excitation. Thus, in the thermo-circuit, the electric current is, at the hot place, from silver to antimony, and from bismuth to silver; but in a voltaic series, including dilute sulphuric or nitric acids, or strong nitric acid, or solution of potash, the electric current is from silver to both antimony and bismuth; whilst if the yellow sulphuret of potash be used, it is from both antimony and bismuth to silver; or if the hydro-sulphuret of potash be used, it is from bismuth to silver, and from silver to antimony; and, finally, if strong muriatic acid be used, it is precisely the reverse, that is, from antimony to silver, and from silver to bismuth. The inconsistency of these results with the contact theory is then insisted on and farther developed.

The last section of this series is on the improbability of there existing any such force as the assumed contact force. The author contends that it is against all natural analogy and probability that two particles which, being placed in contact, have by their mutual action acquired opposite electrical states, should be able to discharge these states one to the other, and yet remain in the same state they were in at the first, that is, entirely unchanged in every point by what has previously taken place; or, that the force which has enabled two particles by their mutual action to attain a certain state, should not be sufficient to make them keep that state. To admit such ef-

fects would be, he thinks, to deny that action and reaction are equal. The contact theory, according to him, assumes that a force which is able to overcome powerful resistance, both chemical and mechanical, can arise out of nothing: that, without any change in the acting matter, or the consumption of any other force, an electric current can be produced, which shall go on for ever against a constant resistance, or only be stopped, as in the voltaic trough, by the ruins which its exertion has heaped in its own course;—this, the author thinks, would be a creation of power, such as there is no example of in nature; and, as there is no difficulty in converting electrical into mechanical force through the agency of magnetism, it would, *if true*, supply us at once with a perpetual motion. Such a conclusion he considers as a strong and sufficient proof that the theory of contact is founded in error.

In a postscript, the author states that he has since found a passage in Dr. Roget's treatise on Galvanism, in the Library of Useful Knowledge, published in January 1829, in which the same argument respecting the unphilosophical nature of the contact-theory is strongly urged*.

* "Were any further reasoning necessary to overthrow it, (namely, the voltaic theory of contact) a forcible argument might be drawn from the following consideration. If there could exist a power, having the property ascribed to it by the hypothesis, namely, that of giving continual impulse to a fluid in one constant direction, without being exhausted by its own action, it would differ essentially from all the other known powers in nature. All the powers and sources of motion with the operation of which we are acquainted, when producing their peculiar effects, are expended in the same proportion as those effects are produced; and hence arises the impossibility of obtaining by their agency a perpetual effect, or, in other words, a perpetual motion. But the electro-motive force ascribed by Volta to the metals when in contact, is a force which, as long as a free course is allowed to the electricity it sets in motion, is never expended, and continues to be exerted with undiminished power, in the production of a never-ceasing effect. Against the truth of such a supposition the probabilities are all but infinite." § 113, p. 32.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1840. No. 43.

April 2, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

His Grace the Duke of Richmond and John Gwyn Jefferys, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.:

"Additional note to the Eleventh Series of Researches on the Tides." By the Rev. William Whewell, B.D., F.R.S., &c.

As an appendix to his former memoir on tide observations, the author gives in the present paper the results of observations made at Petropaulofsk, in the bay of Avatcha, in Kamtchatka, lat. 53° 1′ N., long. 158° 44′ E., by the officers and men of the Seuivine, commanded by the present Russian Admiral Lütke; and which were conducted with great care and perseverance. The height of the surface was noted every ten minutes, both day and night, and when near its maximum every two minutes.

It appears from these observations that the high water is affected in its time by a very large diurnal inequality, reaching the enormous amount of above four hours; while its height is only slightly affected by an inequality of that kind; the greatest alternate inequalities of height were something more than a foot. In the low waters, there appears a much smaller inequality in the times, seldom amounting to more than one hour; but with regard to height, the diurnal inequality is much larger than that for high water, reaching to three, or even four feet; and this in a tide of which the whole rise, from the lowest to the highest, rarely exceeds five feet. The theory of these phenomena is then discussed.

The results of another series of observations made in July 1827, at the port of Novo-Arkhangelsk, in the island of Sitkhœ, in Norfolk Sound (lat. 57° 2′ N., long. 135° 18′ W.), are also given, and their theory considered.

A paper was also in part read, entitled, "On the Nervous System." By Sir Charles Bell, F.R.S.

April 9, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

John P. Gassiot and Thomas Henderson, Esqrs., were balloted for, and duly elected into the Society.

The reading of a paper, entitled, "On the Nervous System." By Sir Charles Bell, F.R.S., was resumed and concluded.

The author adverting to the papers on the nervous system, which he presented to the Royal Society nearly twenty years ago, recapitulates the train of reasoning which originally led him to the inquiries in which he has been so long engaged, on the different functions of different classes of nerves, and adduces various pathological facts in corroboration of the correctness of the views he then entertained. With regard to the spinal nerves, cases are related where, in consequence of disease of the bodies of the vertebræ, the anterior columns of the spinal cord, and anterior roots of the nerves were affected, and paralysis of the muscles to which those nerves are distributed was produced, while the posterior column of the cord was uninjured, and the sensibility unimpaired. The author next considers the respiratory system of nerves, which he regards as being both muscular and sensitive, and describes as arising from a tract of the spinal cord, on the outside of the *corpus olivare*, and anterior to the *processus ad cerebellum*; and which constitute columns having no decussations with one another, as is the case with the other systems. The conclusion he originally formed, that both the phrenic and the spinal accessory nerves are provided for motion, which he had deduced from the anatomical fact of the former taking a direct course to the diaphragm, and the latter a circuitous one for the purpose of associating the muscles of the respiratory organs with those which act on the chest, is, he thinks, amply confirmed by subsequent experiments. He concludes his paper with some remarks on the supply of blood to the respiratory system of nerves, which supply, being derived from branches of the vertebral arteries, affords an explanation of several pathological phenomena.

A paper was also read, entitled, "On the constitution of the Resins. Part IV." By James F. W. Johnston, Esq., M.A., F.R.S.

This paper contains the account of the continuation of the author's previous researches into the constitution of the resins, both as they occur in nature, and as they appear when extracted from the natural products by the agency of alcohol or ether. The great difficulty in this inquiry is to determine when the resin to be analysed is obtained in its normal state; and the author has endeavoured in each case to ascertain this point by repeated analyses of the resins prepared under different conditions. He thus arrives at the conclusion, that the resin of scammony extracted from crude scammony by alcohol, and heated to 260° Fahr., is represented by $C_{40}\ H_{33}\ O_{20}$, con-

taining the largest amount of oxygen of any resin hitherto analysed. The resin of jalap, obtained by evaporating the alcoholic extract, and afterwards boiling it in water, is represented by $C_{40}\ H_{34}\ O_{18}$, and in the amount of oxygen it contains is only surpassed by the resin of scammony. It is interesting to remark that these two resins in their effects on the animal economy are as nearly related as these formulæ show them to be in chemical constitution.

The resin of labdanum, extracted by alcohol from the crude labdanum and evaporated, gave the formula $C_{40}\ H_{33}\ O_8$; but this extract, softened in the air and water, took up from it a bitter substance of a brown colour. After boiling in water, the pure resin is represented by $C_{40}\ H_{33}\ O_7$.

The Berengela resin, previously analysed by the author before he was aware of the conditions necessary to be attended to in order to obtain a resin in its normal state, is expressed by the formula $C_{40}\ H_{30}\ O_7$; and the resin of Retin asphalt, also previously analysed by the author, by $C_{40}\ H_{27}\ O_6$.

The resin of ammonia, extracted by alcohol from the crude gum resin, is represented by $C_{40}\ H_{25}\ O_9$; the resin of opoponax by $C_{40}\ H_{25}\ O_{14}$; and that of assafœtida by $C_{40}\ H_{26}\ O_{10}$.

A striking relation appears between the formulæ for the resins of ammonia and assafœtida, the former being $C_{40}\ H_{25}\ O_9$, the latter $C_{40}\ H_{26}\ O_{10}$, as if the latter were merely a hydrate of the former. The author considers this relation, and concludes that it is only apparent, and that probably in neither of the resins does any of the hydrogen exist in combination with oxygen in the state of water.

This leads the author to inquire into the general action of a slightly elevated temperature on the resins, and he concludes that in all cases when a resin in its normal state is heated a few degrees above its melting point, it begins to suffer partial decomposition, accompanied by the solution of water, and *always* by more or less of a volatile, generally oily compound, sometimes containing less and sometimes more oxygen than the resin which has been subjected to heat. In the case of some resins, especially such as are agreeably fragrant, and are expressed by the second of the author's general formulæ $C_{40}\ H_{24} \pm x\ O_7$, benzoic acid is one of the products of decomposition at a moderate temperature. Thus the resin of dragon's blood gives only a trace of benzoic acid, with water and a red volatile compound; while the resin of benzoin gives much benzoic acid. Some resins give off volatile matters and diminish in weight long before they reach the fusing point; as is the case with the resin of benzoin, of which the melting point is high. With regard to the special action of such temperatures in altering the atomic constitution of the resins, the author finds that each resin undergoes a change, probably peculiar to itself, and probably depending on the nature of the organic radical it contains. Thus, the formula for the resin of retin asphalt ($= C_{40}\ H_{27}\ O_6$) by prolonged heating at the melting point becomes $C_{40}\ H_{27}\ O_5$. Ammonia resin ($= C_{40}\ H_{25}\ O_9$) by heating at 270°

Fahr. *approaches* to $C_{40}\ H_{34}\ O_{8}$; there being, however, a slight excess of oxygen, and water not being the only volatile compound driven off.

The resin of opoponax, when thus heated the hydrogen, as in that of retin asphalt, remains nearly constant $= C_{40}\ H_{25}\ O_{14}$, approaching to $C_{40}\ H_{25}\ O_{12}$. The same is the case with the resin of assafœtida ($= C_{40}\ H_{26}\ O_{10}$), which by prolonged heating at about 250° Fahr., becomes $C_{40}\ H_{26}\ O_{9}$. These observations when multiplied are likely to assist materially in leading to *rational* formulæ, expressive of the molecular constitution of the resins.

In reference to the general questions, with a view to the solution of which the author undertook this investigation, he concludes:

1. That the resins are not to be considered as different compounds of one and the same radical, but rather as analogous groups of compounds of analogous radicals.

2. That as far as our present knowledge extends, all the *true* resins are capable of being represented by irrational formulæ, in which C_{40} is a constant quantity.

3. That the analyses contained in the present paper render necessary a slight modification in the general formulæ previously announced. The formula for the group of which colophony is the type, being $C_{40}\ H_{32} + x\ Oy$; and that for the group of which gamboge or dragon's blood is the type, being $C_{40}\ H_{24} + x\ Oy$.

The author announces a further continuation of these researches, in which the constitution of other resins will be given, and the relations of the resins to certain chemical reagents will be explained and illustrated.

The Society then adjourned over the Easter Recess, to meet again on the 30th instant.

April 30, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

His Royal Highness Prince Albert, of Saxe Coburg and Gotha, K.G., was proposed as a Fellow of the Royal Society by the President, seconded by John W. Lubbock, Esq., V.P. and Treasurer R.S., and, being put to the ballot, H.R.H. was elected a Fellow of the Royal Society.

Lord Lyttleton was also, pursuant to a notice given at the last meeting, put to the ballot, and elected a Fellow of this Society.

Thomas Wharton Jones, Esq., and John Grant Malcolmson, M.D., were also balloted for, and duly elected into the Society.

The following communications were read:—

1. A Letter from Sir John Barrow, Bart., V.P., addressed to the President, accompanying a series of Magnetic Observations made on

shore, and on board Her Majesty's ships 'Erebus' and 'Terror,' under the direction of Captain James Clark Ross, R.N., together with a Series of Observations made on the temperature and specific gravity of the ocean at various depths, and at the surface, namely,

"Observations of the magnetic intensity on shore, and on board H.M.S. Erebus, with needle F. 1.

"Magnetic dip observations on shore, and on board H.M.S. Erebus, with needle F. 1.

"Observations for the magnetic dip on shore, and on board H.M.S. Terror.

"Observations of the magnetic dip by needle F. C. 5. on shore, and on board H.M.S. Terror.

"Observations in magnetic intensity by needle F. C. 5. on shore, and on board H.M.S. Terror."

The whole of these observations are up to the 31st December, 1839. They are transmitted to the Royal Society from the Lords Commissioners of the Admiralty.

2. Postscript to Major Sabine's paper, entitled "Contributions to Terrestrial Magnetism," which was read at the last meeting; containing an extract from a letter from Capt. James Clark Ross, commanding the Antarctic expedition, dated from St. Helena, February 9th, 1840; noticing the success which had attended the employment of Mr. Fox's instrument, in observations of the magnetic dip and intensity on shipboard.

3. "A few remarks on a Rain Table and Map," drawn up by Joseph Atkinson, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The table and map which accompany this paper exhibit the average annual depth of rain falling in different places in Great Britain.

4. "Extracts from a Meteorological Journal kept at Allenheads, in the county of Northumberland," by the Rev. W. Walton, F.R.S.

The general result of these observations, which were recorded twice each day, namely, at 9 A.M., and at 3 P.M., during the whole of the year 1839, is, that the mean temperature taken at those times was 44° 8′; the mean height of the barometer, corrected and reduced to the temperature of 32°, was 28·401 inches, and the quantity of rain in the year was 55·71 inches. The author subjoins several remarks on the conclusions deducible from an examination of the tables.

5. "Description of an Astronomical Clock invented by the late Captain Henry Kater, F.R.S.," drawn up from his own memorandums by his son Edward Kater, Esq. Communicated by Sir John F. W. Herschel, Bart., V.P.R.S.

The great object aimed at by Captain Kater in the construction of the escapement of a chronometer, is to communicate equal impulses

to the pendulum through some principle perfect in itself, and not dependent for its success on superior execution. In the escapement invented by him, the pendulum merely raises a weight, and is impelled by that weight through an increased space in its descent. It neither unlocks a detent, nor has anything to do with the train; and as the weight raised, and the spaces described, are constant quantities, this escapement is, in the strict meaning of the term, one of equal impulse.

May 7, 1840.

JOHN WM. LUBBOCK, Esq., M.A., V.P. and Treasurer, in the Chair.

John Auldjo, Esq., and William Sharp, Esq, were balloted for, and duly elected into the Society.

A paper was read, entitled "Researches in Embryology, Third Series: a Contribution to the Physiology of Cells." By Martin Barry, M.D., F.R.S., F.R.S.E., Fellow of the Royal College of Physicians in Edinburgh.

In the second series of these researches, the author had traced certain changes in the mammiferous ovum consequent on fecundation. The object of his present communication is to describe their further appearances obtained by the application of higher magnifying powers; and to make known a remarkable process of development thus discovered. In order to obtain more exact results, his observations were still made on the same animal as before, namely, the rabbit, in the expectation that, if his labours were successful, it would be comparatively easy to trace the changes in other mammals. By pursuing the method of obtaining and preserving ova from the Fallopian tube which he recommended in his last paper, he has been enabled to find and examine 137 more of these delicate objects; and has thus had ample opportunity of confirming the principal facts therein stated. He has now procured in all 230 ova from the Fallopian tube. But being aware that repeated observations alone do not suffice in researches of this nature, unless extended to the very earliest stages, he again specially directed his attention to the ovum while it is still within the ovary, with a view to discover its state at the moment of fecundation, as well as immediately before and after that event.

The almost universal supposition, that the Purkinjian or germinal vesicle is the essential portion of the ovum, has been realized in these investigations; but in a manner not anticipated by any of the numerous conjectures which have been published. The germinal vesicle becomes filled with cells, and these again become filled with the foundations of other cells; so that the vesicle is thus rendered almost opake. The mode in which this change takes place is the

following, and it is one which, if confirmed by future observation, must modify the views recently advanced on the mode of origin, the nature, the properties, and the destination of the nucleus in the physiology of cells. It is known that the germinal spot presents, in some instances, a dark point in its centre. The author finds that such a point is invariably present at a certain period; that it enlarges, and is then found to contain a cavity filled with fluid, which is exceedingly pellucid. The outer portion of the spot resolves itself into cells; and the foundations of other cells come into view in its interior, arranged in layers around the central cavity; the outer layers being pushed forth by the continual origin of new cells in the interior. The latter commence as dark globules in the pellucid fluid of the central cavity. Every other nucleus met with in these researches has seemed to be the seat of changes essentially the same. The appearance of the central portion of the nucleus is, from the above process, continually varying; and the author believes that the nature of the nucleolus of Schleiden is to be thus explained. The germinal vesicle, enlarged and flattened, becomes filled with the objects arising from the changes in its spot; and the interior of each of the objects filling it, into which the eye can penetrate, presents a repetition of the process above described. The central portion of the altered spot, with its pellucid cavity, remains at that part of the germinal vesicle which is directed towards the surface of the ovum, and towards the surface of the ovary. At the corresponding part, the thick transparent membrane of the ovum in some instances appears to have become attenuated, in others also cleft. Subsequently, the central portion of the altered spot passes to the centre of the germinal vesicle; the germinal vesicle, regaining its spherical form, returns to the centre of the ovum, and a fissure in the thick transparent membrane is no longer seen. From these successive changes it may be inferred that fecundation has taken place; and this by the introduction of some substance into the germinal vesicle from the exterior of the ovary. It may also be inferred, that the central portion of the altered germinal spot is the point of fecundation. In further proof that such really is the case, there arise at this part two cells, which constitute the foundation of the new being. These two cells enlarge, and imbibe the fluid of those around them, which are at first pushed further out by the two central cells, and subsequently disappear by liquefaction. The contents of the germinal vesicle thus enter into the formation of two cells. The membrane of the germinal vesicle then disappears by liquefaction.

Each of the succeeding twin cells presents a nucleus, which, having first passed to the centre of its cell, resolves itself into cells in the manner above described. By this means the twin cells, in their turn, become filled with other cells. Only two of these in each twin cell being destined to continue, the others, as well as the membrane of each parent-cell, disappear by liquefaction, when four cells remain. These four produce eight, and so on, until the germ consists of a mulberry-like object, the cells of which do not admit

of being counted. Nor does the mode of propagation continue the same with reference to number only. The process inherited from the germinal vesicle by its twin offspring, reappears in the progeny of these. Every cell, whatever its minuteness, if its interior can be discerned, is found filled with the foundations of new cells, into which its nucleus has been resolved. Together with a doubling of the number of the cells, there occurs also a diminution of their size. The cells are at first elliptical, and become globular.

The above mode of augmentation, namely the origin of cells in cells, appears by no means to be limited to the period in question. Thus it is very common to meet with several varieties of epithelium-cells in the oviduct, including those which carry cilia, filled with cells; but the whole embryo at a subsequent period is composed of cells filled with the foundations of other cells.

In the second series of these researches, it was shown that the mulberry-like object above mentioned, is found to contain a cell larger than the rest, elliptical in form, and having in its centre a thick-walled hollow sphere, which is the nucleus of this cell. It was further shown that this nucleus is the rudimental embryo. From what has been just stated, it appears, that the same process, by which a nucleus in one instance transforms itself into the embryo, is in operation in another instance, where the product does not extend beyond the interior of a minute and transitory cell. Making allowance, indeed, for a difference in form and size, the description given of the one might be applied to the other. It was shown in the second series, that in the production of the embryo out of a nucleus, layer after layer of cells come into view in the interior, while layers previously formed are pushed further out; each of the layers being so distinctly circumscribed as to appear almost membranous at its surface. The same membranous appearance presents itself at the surface of the several layers of a nucleus in many situations. Farther, in the formation of the embryo, a pellucid centre is the point around which new layers of cells continually come into view; a centre corresponding to that giving origin to similar appearances in every nucleus described in the present memoir. It was shown that in the embryo this mysterious centre is present until it has assumed the form of the cavity, including the sinus rhomboidalis, in the central portion of the nervous system.

The process above described as giving origin to the new being in the mammiferous ovum, is no doubt universal. The author thinks that there is evidence of its occurrence in the ova of batrachian Reptiles, some osseous Fishes, and certain of the Mollusca; though the explanation given of these has been of a very different character. It has hitherto been usual to regard the round white spot, or cicatricula, on the yelk of the bird's laid egg, as an altered state of the discus vitellinus in the unfecundated ovarian ovum. So far from thinking that such is the case, the author believes the whole substance of the cicatricula in the laid egg to have its origin within the germinal vesicle, in the same manner as in the ovum of Mammalia.

There is no fixed relation between the degree of development of

ova, and their size, locality, or age. The variation with regard to size is referable chiefly to a difference in the quantity of fluid imbibed in different instances by the incipient chorion. Vesicles filled with transparent fluid are frequently met with in the Fallopian tube, very much resembling the thick transparent membrane of the ovarian ovum. These vesicles are probably unimpregnated ova, in the course of being absorbed. The so-called "yelk" in the more or less mature ovarian ovum, consists of nuclei in the transition state and exhibiting the compound structure above described. The mass of these becomes circumscribed by a proper membrane. They and their membrane subsequently disappear by liquefaction, and are succeeded by a new set, arising in the interior, and likewise becoming circumscribed by a proper membrane, and so on. This explains why some observers have never seen a membrane in this situation. After the fecundation of the ovum, the cells of the tunica granulosa, that is, part of the so-called "disc," are found to have become club-shaped, greatly elongated, filled in some instances with cells, and connected with the thick transparent membrane by their pointed extremities alone.

That the thin membrane described by the author in his second series as rising from the thick transparent membrane in the Fallopian tube, and imbibing fluid, is really the incipient chorion, was then shown by tracing it from stage to stage, up to the period when villi form upon it. There remained, however, two questions undecided; viz., whether the chorion is formed of cells, and if so, whether the cells are those of the so-called "disc," brought by the ovum from the ovary. The author now states that the chorion is formed of cells, which gradually collect around the thick transparent membrane, and coalesce; and that the cells in question are *not* those of the "disc" brought with the ovum from the ovary. The cells which give origin to the chorion are intended to be more particularly described in a future paper.

The existing view, namely, that a nucleus, when it leaves the membrane of its cell, simply disappears by liquefaction, is inapplicable to any nucleus observed in the course of these investigations. The nucleus resolves itself into incipient cells in the manner above described. In tracing this process, it appears that the nucleus, and especially its central pellucid cavity, is the seat of changes which were not to have been expected from the recently advanced doctrine, that the disappearing nucleus has performed its entire office by giving origin at its surface to the membrane of a single cell. It is the mysterious centre of a nucleus which is the point of fecundation; and the place of origin of two cells constituting the foundation of the new being. The germinal vesicle, as already stated, is the parent cell, which, having given origin to two cells, disappears, each of its successors giving origin to other two, and so on. Perpetuation, however, at this period, consists, not merely in the origin of cells in cells, but in the origin of cells in the pellucid central part of what had been the nucleus of cells.

The author shows that neither the germinal vesicle, nor the pel-

lucid object in the epithelium-cell, is a cytoblast. He suggests, that the cells into which, according to his observations, the nucleus becomes resolved, may enter into the formation of secondary deposits —for instance, spiral fibres; and that they may contribute to the thickening which takes place, in some instances, in the cell-membrane.

The germ of certain plants passes through states so much resembling those occurring in the germ of mammiferous animals, that it is not easy to consider them as resulting either from a different fundamental form, or from a process of development which even in its details is not the same as what has been above described; the fundamental form in question in Mammalia—and therefore it may be presumed of Man himself—being that which is permanent in the simplest plants,—the single isolated cell.

A paper was also read, entitled "On the Odour accompanying Electricity, and on the probability of its dependence on the presence of a new substance;" by C. F. Schœnbein, Professor of Chemistry, Bâle, communicated in a letter to Michael Faraday, Esq., D.C.L., F.R.S., &c.

The author's attention having been long directed to the remarkable fact, that odour, resembling that of phosphorus, is given off during the escape of positive electricity from the point of a conductor into air; and is likewise perceptible when lightning has struck any object, and also when water is electrolyzed, he has investigated the circumstances attending these phenomena; and the results he has obtained will, he expects, afford a clue to the discovery of their cause.

The odour which accompanies the electrolyzation of water, he observes, is only disengaged at the positive electrode. He also finds that the odoriferous principle can be preserved in well-closed glass bottles for any length of time. The only metals which yield this odour are gold and platina; but dilute sulphuric, phosphoric, and nitric acids, and from aqueous solutions of several of the salts, also disengage it. Raising the temperature of the fluid to the boiling point prevents the odour from arising; and the addition of comparatively small quantities of powdered charcoal, iron, zinc, tin, lead, antimony, bismuth or arsenic, or of a few drops of mercury, to the odorous principle contained in a bottle, immediately destroys the smell; and the same happens when platina or gold, heated red hot, is introduced into the vessel containing that volatile substance.

May 14, 1840.

MAJOR EDWARD SABINE, R.A. V.P., in the Chair.

A paper was read, entitled, "Tables of the Variation, through a cycle of nine years, of the mean height of the Barometer, mean Temperature, and depth of Rain, as connected with the prevailing

Winds, influenced in their direction by the oceurrence of the Lunar Apsides, with some concluding observations on the result." By Luke Howard, Esq., F.R.S., &c.

From the Tables here given, the author draws the following conclusions :—

1. The barometer is higher under the lunar apogee, than under the perigee; the mean height in the former case being 29·84517, and in the latter, 29·75542.

2. The mean temperature is lower under the apogee than under the perigee; that of the former being 48°·7126, and of the latter, 49°·0356. The mean of the whole year was 48°·7126.

3. The rain of the weeks following the apsis exceeds that under the perigee; but with two striking exceptions in the annual result of nine years, the one in the wettest, and the other in the driest year of the cycle.

With regard to the winds, the author remarks that those from the north, north-east, and east, prevailed under the apogee on 38 days, under the perigee on 21 days; and those from the south, south-west, and west, prevailed under the apogee on 20 days, under the perigee on 38 days.

It appears, therefore, that in the climate of London, the moon in her perigee brings over us the southern atmosphere, which tends to lower the density and raise the temperature of the air, occasioning also a larger precipitation of rain. In the apogee, on the contrary, there is a freer influx of air from the northward, a higher barometer, a lower temperature, and less rain; subject, however, to a large addition of rain under this apsis twice in a cycle of nine years, at the times when also the extremes of wet and dry take place on the whole amount of the year.

A paper was also read entitled, "Experimental Researches into the strength of Pillars of Cast Iron, and other materials." By Eaton Hodgkinson, Esq. Communicated by Peter Barlow, Esq., F.R.S., &c.

The author finds that in all long pillars of the same dimensions, the resistance to crushing by flexure is about three times greater when the ends of the pillars are flat, than when they are rounded. A long uniform cast-iron pillar, with its ends firmly fixed, whether by means of disks or otherwise, has the same power to resist breaking as a pillar of the same diameter, and half the length, with the ends rounded, or turned so that the force would pass through the axis. The strength of a pillar with one end round and the other flat, is the arithmetical mean between that of a pillar of the same dimensions with both ends round, and one with both ends flat. Some additional strength is given to a pillar by enlarging its diameter in the middle part.

The author next investigated the strength of long cast-iron

pillars with relation to their diameter and length. He concludes that the index of the power of the diameter, to which the strength is proportional, is 3·736. He then proceeds to determine, by a comparison of experimental results, the inverse power of the length to which the strength of the pillar is proportional. The highest value of this power is 1·914, the lowest, 1·537, the mean of all the comparisons, 1·7117. He thus deduces, first, approximate empirical formulæ for the breaking weight of solid pillars, and then proceeds to deduce more correct methods of determining their strength.

Experiments on hollow pillars of cast iron are then described, and formulæ representing the strength of such pillars are deduced from these experiments.

After giving some results of experiments still in progress for determining the power of cast-iron pillars to resist long-continued pressure, the author proceeds to determine from his experiments the strength of pillars of wrought iron and timber, as dependent on their dimensions. The conclusion for wrought iron is, that the strength varies inversely as the square of the pillar's length, and directly as the power 3·75 of its diameter, the latter being nearly identical with the result obtained for cast iron; for timber, the strength varies nearly as the 4th power of the side of the square forming the section of the pillar. Experiments for determining the relation of the strength to the length in pillars of timber, were not instituted, as, from the great flexure of the material, it was considered that no very satisfactory conclusions on this point could be derived experimentally.

In conclusion, the author gives the relative strengths of long pillars of cast iron, wrought iron, steel, and timber.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1840. No. 44.

May 21, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

William Burge, Esq., Walter Ewer, Esq., Thomas Tassell Grant, Esq., and Henry Lawson, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.:

1. "Remarks on the Meteorological Observations made at Alten, Finmarken, by Mr. S. H. Thomas in the years 1837, 1838, and 1839." By Major Sabine, R.A., V.P.R.S., and Lieut .Col. Sykes, F.R.S.; being a Report from the Committee of Physics, including Meteorology, to the Council, and communicated by the Council to the Royal Society.

These observations, made at Alten in lat. 69° 58′ 3″ N., and 23° 43′ 10″ east of Paris, would seem to have a claim to the attention of the Royal Society, as they offer the *experimentum crucis* of Professor Forbes's empirical formula respecting the gradual diminution of the daily oscillations of the barometer, within certain limit hours, from the equator to the poles. Professor Forbes has laid down an assumed curve, in which the diurnal oscillation amounts to ·1190 at the equator and 0 in lat. 64° 8′ N., and *beyond that latitude* the tide should occur *with a contrary sign*, plus becoming minus. Now Alten being nearly in lat. 70°, if Professor Forbes's law hold good, the maxima of the diurnal oscillations should occur at the hour for the minima at the equator, and a similar inversion should take place with respect to the minima. Mr. Thomas has himself however modified the value his observations would otherwise have had, by adopting 2 P.M., instead of 3 P.M., for the hour of his observations for the fall; and he has adapted his barometrical observations to a mean temperature of 50° Fahr., instead of 32°. The first year's observations commence on the 1st October, 1837, and terminate on the 30th September, 1838. The barometer stood 66 feet 5 inches above low-water mark, and the thermometer hung at 6 feet above the ground; but care was not always taken to prevent the sun shining on it. The mean height of the barometer for the year was 29°·771, and the mean of the thermometer almost coincident with the freezing point, viz., 32°·017. The

maximum height of the barometer was 30°·89 in January, and the minimum 28°·71 in October. The mean of the barometer at 9 A.M. was 29°·764, therm. 33°·455; at 2 P.M. 29°·765, therm. 33°·327; and at 9 P.M. 29°·784, therm. 29°·270. The diurnal observations would seem to support Professor Forbes's theory; but the 9 P.M. observations are entirely opposed to it, as they appear with the same maximum sign as at the equator, whereas the sign ought to have been the reverse; indeed, with respect to the diurnal observations, the mean of five months of the year at 9 A.M. gives a plus sign, although the mean of the year at 2 P.M. only gives the trifling quantity of ·001 plus. There is one remarkable feature in these observations that cannot fail to strike the meteorologist. M. Arago, from nine years' observations at Paris, reduced to the level of the sea, makes the annual mean height 29°·9546; twenty-one years' observations at Madras make it 29°·958; and three years' observations at Calcutta, by Mr. James Prinsep, make it 29°·764; and Mr. Thomas brings out 29°·771. That there should be this coincidence between the observations at Calcutta and Alten is curious. Neither Mr. Thomas nor Mr. Prinsep state whether or not their means are reduced to the level of the sea. It is to be suspected they are not.

For the next year, that is to say, from Oct. 1838 to Sept. 1839, both inclusive, Mr. Thomas uses a French barometer and French measurements, with centigrade thermometer attached to the barometer, and Fahrenheit's for the detached thermometer. He changes his time of observation from 9 A.M. to 8 A.M., 2 P.M., and 8 P.M., and he reduces his barometrical observations to 0 centigrade. The results of the year are as follow:—mean annual pressure 29°·627 English; thermometer Fahr. 33°·36; greatest pressure in April, least in January!! The mean of 8 A.M. is 29°·620; therm. 33°·75. The mean of 2 P.M.. is 29°·631; therm. 34°·73. And at 8 P.M. 29°·631; therm. 30°·57. The diurnal observations assist to support Professor Forbes's theory; but as in the preceding year, the P.M. observation is at fault; and if the hour had been 9 o'clock instead of 8 o'clock, it would probably have been more so than it appears. The low annual mean state of the barometer for the year 1837–38 is even increased in the last year's observations; and as fresh instruments* appear to have been used, there is ground to believe that the fact is associated with the locality, and it may be desirable not only to record in the Proceedings of the Royal Society the data already supplied, but to recommend to Mr. Thomas more particular inquiry on the subject.

The phænomena of the Aurora Borealis appear to have been observed by Mr. Thomas with great assiduity, and recorded with great care. On examining the register, with reference to M. Erman's important remark, that "in Siberia two kinds of aurora are distinguished, one having its centre in the west, and the other in the east, the latter being the more brilliant," it is found that twenty-two

* It appears that the barometer was compared before leaving France, and subsequently to its being taken back to that country.

nights occur in the course of the two winters in which the formation of arches of the aurora is noticed and their direction recorded; of these, *ten* are to the *west*, having their centres rather to the southward of west, the arches extending from N.W. to S.S.E. and S.E.; *seven* are to the *east*, or more precisely to the southward of east, the arches extending from N.E. to S.E. and S.W. Of the five others, *four* are said to be from east to west across the zenith, and cannot therefore be classed with either of the preceding, and *one* is noticed generally as being to the north. The facts here recorded appear to afford an evidence of the same nature as those mentioned by M. Erman, as far as regards there being two centres of the phænomena. In respect to the relative brilliancy of the eastern and western aurora, nothing very decided can be inferred from the register. If, as M. Erman supposes, that they may be referred respectively to "les deux foyers magnétiques de l'hemisphère boréal," it is proper to notice that the position of Alten is nearly midway between those localities.

There can be no doubt that the frequent appearance of the aurora, and the peculiarities of the phænomena observed there, render it a most desirable quarter for a magnetical and meteorological observatory.

EDWARD SABINE.
W. H. SYKES.

2. "Second Letter on the Electrolysis of Secondary Compounds, addressed to Michael Faraday, Esq., D.C.L., F.R.S., &c." By J. Frederic Daniell, Esq., For. Sec. R.S., Professor of Chemistry in King's College, London.

The author, in this letter, prosecutes the inquiry he had commenced in the former one, into the mode in which the chemical elements group themselves together to constitute *radicles*, or proximate principles. He considers his experiments as establishing the principle that, considered as electrolytes, the inorganic oxy-acid salts must be regarded as compounds of metals, or of that extraordinary compound of nitrogen and four equivalents of hydrogen to which Berzelius has given the name of *ammonium*, and compound anions, chlorine, iodine, &c., of the Haloide salts; and as showing that this evidence goes far to establish experimentally the hypothesis originally brought forward by Davy, of the general analogy in the constitution of all salts, whether derived from oxy-acids or hydro-acids. Some remarks are made on the subject of nomenclature, and the rest of the paper is occupied with the details of the experiments, all bearing on the important subject which he has undertaken to investigate.

May 28, 1840.

FRANCIS BAILY, Esq., V.P., in the Chair.

The ballot for the Right Rev. the Lord Bishop of Norwich was deferred until the next meeting of the Society, there not being a sufficient number of Fellows present.

The following papers were read, viz.:

1. " Meteorological Register kept at Port Arthur, Van Diemen's Land, during the year 1838, and Register of Tides at Port Arthur, from August 1838 to July 1839, both inclusive." By Deputy-Assistant-Commissary-General Lempriere. Communicated by Sir John Franklin, R.N., F.R.S., &c.

2. " Notice relative to the form of the Blood-particles of the *Ornithorhynchus hystrix*." By John Davy, M.D., F.R.S.

A portion of the blood of the *Ornithorhynchus hystrix*, mixed when fresh with a strong solution of common salt, being examined by the author, exhibited a few globules of irregular shape. Another portion, preserved in syrup, contained numerous globules, most of which had an irregular form, but many were circular; none, however, were elliptical, like those of birds. Hence the author concludes, that in form they accord more with those of Mammalia.

3. " Researches on Electro-chemical equivalents, and on a supposed discrepancy between some of them and the atomic weight of the same bodies, as deduced from the theory of isomorphism." By Lieut.-Colonel P. Yorke. Communicated by Michael Faraday, Esq., D.C.L., F.R.S., &c.

The author describes various experiments made with a view to determine the electro-chemical equivalents of sodium and potassium. Three experiments gave, respectively, 22·3, 22·9, and 25, as the equivalent of the former; and two other experiments gave, respectively, 45 and 41·7, as the equivalent of the latter of these substances. He then inquires what would be the result of the electrolyzation of the aqueous solutions of soda and potash, on the hypothesis of these bodies being composed of two equivalents, or atoms, of metal, and one of oxygen. To determine this question he employs a solution of dichloride of copper in muriatic acid, as being a substance composed of two atoms of metal and one of an electronegative element. Its electrolysis gave as the equivalent of copper, 52·8, 59·4, and 61·6, numbers approximating closely to 63·2, or double the atomic weight of copper. After a long train of investigation, he concludes that there is no reason deducible from the theory of isomorphism for doubting the correctness of the received atomic weights of silver, sodium, &c., but that the difficulty, or anomaly, if it may be so called, should be considered as attaching itself to the di-compounds of copper; and that Faraday's propositions on this subject remain unimpeached.

4. " Second series of Approximate Deductions made from about 50,000 observations taken during the years 1836, 1837, and 1838, at the P. Louis Observatory, Mauritius, four times each day; namely, at 8 A.M., at noon, and at 4 and 8 P.M." By J. A. Lloyd, Esq., F.R.S.

5. " On the Solubility of Silica by Steam; with an account of an experiment on the subject, conducted in the East Indies by

Julius Jeffreys, late of the Hon. East India Company's Medical Establishment."

The inner surfaces of a flue built of siliceous bricks appeared to be deeply eroded by the passage over it of steam at a very high temperature, and fragments of siliceous materials laid in the course of the current were partially consumed. A siliceous crust was deposited on several vessels of stone ware, coated with a micaceous glaze, placed in the upper part of the furnace, and this crust was re-dissolved when the vessels were removed to a hotter situation in the same furnace. The author notices the experiments of Dr. Turner and others, which failed in showing the solubility of silica by steam, in consequence, as he conceives, of the heat having not been sufficiently great to effect the solution.

June 4, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Justus Liebig, Johannes Müller, and Jacques Charles François Sturm, were severally elected Foreign Members of the Society.

The Right Rev. the Lord Bishop of Norwich, Lieut. Thomas Cook, R.N., and William Hutton, Esq., were balloted for, and duly elected into the Society.

A paper was read, entitled, "Contributions to the Chemical History of Archil and of Litmus." By Robert Kane, M.D., M.R.I.A. Communicated by Francis Baily, Esq., V.P.R.S.

After a preliminary sketch of the labours of Heeren and of Robiquet in investigating the origin of the beautiful colouring materials termed *Archil* and *Litmus,* obtained from different kinds of colourless lichens, and their detection of the two proximate principles termed *erythrine* and *orceine,* the author states the object of the inquiries detailed in the present paper to be threefold; viz. first, to ascertain the primitive form of the colour-making substance in a given species of lichen, and trace the stages through which it passes before the coloured substance is developed; secondly, to determine the nature of the various colouring substances which exist in the archil of commerce; and thirdly, to examine the colouring materials of ordinary litmus. He finds in the lichen *Roccella tinctoria* the following bodies, either pre-existing in the plant, or formed during the processes employed for its analysis: 1. Erythryline; 2. Erythrine (the Pseudo-erythrine of Heeren); 3. Erythrine bitter; 4. Telerythrine; and 5. Roccelline (the Roccellic acid of Heeren). The properties and constitution of these substances are then described, and the chemical formulæ given, which are deducible from their respective analyses. The author finds the archil of commerce to consist essentially of three ingredients, namely, orceine, erythroleic acid, and azoerythrine; of each of the two former there exist two modifications,

and there is, in addition, a yellow matter. After comparing his results with those obtained by Heeren, by an examination of the products evolved by his erythrine in contact with air and with ammonia, and stating reasons for some changes in nomenclature, the author gives the chemical formulæ resulting from his own analysis of these different substances.

His inquiries into the constitution of ordinary litmus, which form the last division of his subject, lead him to the conclusion that that substance contains the principles designated by him as Erythrolein, Erythrolitmine, Azolitmine, and Spaniolitmine; and that the colouring constituents of litmus are, in their natural condition, red; the blue substances being produced by combination with a base, which bases in that of commerce are lime, potass, and ammonia; and there is mixed up in the mass a considerable quantity of chalk and sand. The details of the analyses of these several substances, and the resulting chemical formulæ representing their constitution, are then given.

The concluding section of the paper is occupied by an inquiry into the decoloration of the bodies which exist in archil and in litmus. The latter of these, the author concludes, is reddened by acids, in consequence of their removing the loosely combined ammonia by which the blue colour is produced; and the so-called hydrogen acids liberate the colouring matter by their combining with the alkali to form bodies (either chlorides or iodides), with which the colouring matter has no tendency to unite. Hence it appears that the reddening of litmus is no proof that chloride of hydrogen is an acid, and that the double decomposition which occurs is the same in principle, whether hydrogen or a fixed metal come into play. After detailing the blanching effects of other deoxydizing agents on the colouring matter of litmus, and the action of chlorine on orceine and azolitmine, the author remarks, that in these actions chlorine is subjected to conditions different from those which determine the nature of the results with the generality of organic bodies, and that the displacement of hydrogen, so marked in other cases, does not exist in the class of substances under consideration; but that, in reality, the products of the bleaching energy of chlorine resemble in constitution the compounds of chlorine which possess bleaching powers.

A paper was also read, entitled, "On the Corpuscles of the Blood." By Martin Barry, M.D., F.R.S.

The author in the course of his researches in Embryology, detailed in his "third series," observed that some of the corpuscles of the blood undergo progressive alterations in their structure. The corpuscles so altered he believes to be of the same kind as those described by Professor Owen; and having found that the alterations in question terminate in a separation of the corpuscles into globules, he thinks this fact confirms the idea of Professor Owen—that the blood-disc undergoes spontaneous subdivision. The author farther observed that the corpuscles of the blood, in certain altered states, undergo rapid and incessant changes of form, which cannot be traced

to the action of neighbouring cilia. A corpuscle will sometimes assume the figure of an hour-glass, as if it were preparing to divide itself into two parts, but it instantaneously either regains its previous form, or assumes a new one. These motions are incessant, and so rapid that it is not easy to catch and delineate any of the resulting forms; they are compared to the writhings of an animal in pain. The author has seen them in a rabbit, as late as two hours and a half after death, and thinks it probable that they may continue for a longer time, although, when under the microscope, they gradually and in a short time cease; the rapid changes of form, which are at first apparent, passing into gentle undulations, and being succeeded by an alternation of rest and motion.

Should these facts be thought to confirm the opinion of John Hunter, that the blood "has life within itself," or "acquires it in the act of forming organic bodies," because its corpuscles in certain states exhibit "vital actions," still his assertion that "the red globules" are the least important part of the blood, will appear to have no just foundation.

The author finds that the phenomena attending what is called "vital turgescence" of the blood-vessels, depend not merely on an accumulation and stagnation of blood, but on changes in the condition of its corpuscles, which assume a more or less globular, or elliptical appearance resembling cells. Their interior is dark, from a great increase of red colouring matter which accumulates around a pellucid and colourless point, corresponding in situation to that of the central part of nuclei in other cases; and so completely do the corpuscles fill their vessels, that the fluid portion of the blood is excluded, and the corpuscles are compressed into polyhedral forms. This condition of the blood-corpuscles during vital turgescence of the vessels, the author thinks deserving of consideration, in connexion with many of the phenomena attending local accumulations of blood, both in health and in disease; and more especially with reference to increased pulsation, the exudation of colourless fluid, and the heat and redness of inflamed parts.

According to the views of the author, the formation and nourishment of organs is not effected merely by the fluid portion of the blood, for he has discovered that the cells which he showed in his "Third Series of Researches in Embryology" form the chorion, are altered blood-corpuscles; and he has farther found that muscular fibre (that is, the future muscle-cylinder, not the fibril) is formed by the coalescence of cells, which also are derived from corpuscles of the blood. He has seen and figured every stage of transition, from the unaltered blood-corpuscle to the branched cells forming the chorion, on the one hand, and to the elliptical or oblong muscle-cells, on the other. The colour is not changed, except that the blood-corpuscles, when passing into cells for the formation of muscle, become of a much deeper red. There seems to occur in these an increase of red colouring matter.

Valentin, in describing the mode of the formation of muscle, had stated that globules approach one another and coalesce to form

threads, which in many places have the appearance of a necklace, but subsequently lose the traces of division, and become cylinders. Schwann had conjectured that the globules just referred to—as having been observed by Valentin—are cells, and that these cells coalesce to form a secondary cell, that is, the muscle-cylinder. The author confirms the observations of Valentin and the conjectures of Schwann, with the addition, that the globules coalescing to form the muscle-cylinder are blood-corpuscles which have become cells. The fibrils appear to be subsequently formed within the cylinder, which thus becomes the muscular fasciculus. The medullary portion of the cylinder appears to be composed of the pellucid objects, one of which is contained within each altered blood-corpuscle. Some of these pellucid objects, however, continue to occupy a peripheral situation.

The author thinks it is not probable that muscular fibre and the chorion are the only tissues formed by the corpuscles of the blood; he is disposed rather to inquire, how many are the tissues which they do not form? Nerves, for instance, are known to arise very much in the same manner as muscle-cylinders; and epithelium-cells sometimes present appearances which have almost suggested to the author the idea that they were altered corpuscles of the blood.

Schwann had prevously shown that "for all the elementary parts of organisms there is a common principle of developement,"—the elementary parts of tissues having a like origin in cells, however different the functions of those tissues. The facts made known in the present memoir not only afford evidence of the justness of the views of Schwann, but they farther show that objects, such as the corpuscles of the blood, having all the same appearance, enter immediately into the formation of tissues which physiologically are extremely different. Some of these corpuscles arrange themselves into muscle, and others become metamorphosed into constituent parts of the chorion. But the author thinks it is not more difficult to conceive corpuscles having the same colour, form, and general appearance, undergoing transformations for very different purposes, than to admit the fact made known by two of his preceding memoirs,—namely, that the nucleus of a cell, having a central situation in the group which constitutes the germ, is developed into the whole embryo, while the nuclei of cells occupying less central situations in the group, form no more than a minute portion of the amnion. It is known that in the bee-hive a grub is taken—for a special purpose—from among those born as workers, which it perfectly resembles until nourished with peculiar food, when its developement takes a different course from that of every other individual in the hive.

The Society then adjourned over the Whitsun Recess, to meet again on the 18th instant.

June 18, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Jean Baptiste Dumas, was elected a Foreign Member of the Society.

Lieutenant-Colonel John George Bonner, E.I.C.S., and John Narrien, Esq., were balloted for, and duly elected into the Society.

The President informed the Meeting that the Council had voted the following Addresses of Congratulation to Her Majesty the Queen, and His Royal Highness Prince Albert, on the occasion of the late traitorous attack made upon their lives.

"*To the Queen's Most Excellent Majesty.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, deeply penetrated with feelings of indignation and abhorrence at the treasonable and atrocious attack lately made on Your Majesty's sacred person, beg leave to approach your Throne, and to offer our heartfelt congratulations on Your Majesty's providential escape from the wicked designs of an assassin.

"We lift up our hearts in joyful thankfulness to the Almighty Disposer of Events for his merciful protection of a life so dear to all Your Majesty's subjects, and so important to the welfare and prosperity of these realms; and we most earnestly pray that the same Providence, so signally manifested on the late event, may continue to shield Your Majesty from every danger; and that during a long, prosperous and happy reign, Your Majesty may live in the enjoyment of the affection and prayers of a grateful and united people."

"*To His Royal Highness Prince Albert of Saxe-Coburg and Gotha.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, approach your Royal Highness with the expression of our heartfelt gratitude to the Almighty Disposer of Events for the protection of Her Majesty and Your Royal Highness from the traitorous attack of an assassin, and to offer our sincere congratulations for the safety of a life so important to the welfare of this great empire, as well as to the happiness of our beloved Sovereign.

"In offering these our sentiments, we cannot forget that Your Royal Highness, by becoming one of our members, has proclaimed to the world Your Royal Highness's attachment to those sciences

for the advancement of which our Society was established, and which tend at the same time to the glory of the nation that protects them, and to the happiness of the whole civilized world."

These Addresses were unanimously adopted by the Society.

The following letter was read from G. G. Anson, Esq., addressed to the President, enclosing a specimen of a deposit with which nine acres of land near Exeter, belonging to Lord Radnor, had been covered after the subsidence of a flood, and which was sent by H.R.H. Prince Albert, F.R.S.:—

"*Buckingham Palace, June* 8, 1840.

"My dear Lord,

"His Royal Highness Prince Albert has commanded me to forward to you the enclosed specimen, which has been sent up to His Royal Highness from Lord Radnor's place near Exeter, where nine acres of land were covered with this curious substance after a flood had subsided. His Royal Highness thinks it very probable that the subject may already have been brought before the Royal Society, but in case it should not have been, he sends the accompanying packet. It is said that a good deal of it has been applied to the purpose of making waistcoats for poor people.

"Believe me,
"My dear Lord,
"Yours very faithfully,
"G. G. Anson.

"*The Marquis of Northampton, President of the Royal Society.*"

The following description of the specimen referred to in the letter, drawn up by John Lindley, Ph. D. F.R.S., was also read:

"Description of the Specimen referred to in the preceding letter." By John Lindley, Ph. D., F.R.S.

The plant which overran Lord Radnor's land is the *Conferva crispa* of Dillwyn, which is said to be the *Conferva fluviatilis* of Linnæus. The species inhabits fresh water, and multiplies with great rapidity, forming entangled strata. The green portion is the Conferva in its young state, the white portion is the plant old and bleached. The whole mass consists of articulated filaments, among which are fragments of grass-leaves.

The following papers were then read, or their titles announced:—

1. An Account of Experiments on the Reflecting Telescope. By the Right Hon. Lord Oxmantown, F.R.S.

This paper enters minutely into the details of the experiments, of the precautions requisite to ensure success, and of the manipulations ultimately adopted in forming a speculum three feet in diameter, subsequently applied to a telescope, mounted in a manner very similar to that of Sir John Herschel. The author states, as the results he arrived at, that specula can be made to act effectively, when cast of the finest speculum metal, in separate portions, and retained in

their positions by an alloy of zinc and copper, as easily wrought as common brass, and that they can be executed in this manner of any required size; that castings of the finest speculum metal can be executed of large dimensions, perfect, and not very liable to break; that machinery can be employed with the greatest advantage in grinding and polishing specula; that to obtain the finest polish, it is not necessary that the speculum should become warm, and that any temperature may be fixed upon, and preserved uniform during the whole process; and that large specula can be polished as accurately as small ones, and be supported so as to be secured from flexure.

2. On the theoretical explanation of an apparently new Polarity in Light. By G. B. Airy, Esq., M.A., F.R.S., Astronomer Royal.

The existence of a polarity in the rays of homogeneous light, having regard only to the sequence of colours in the spectrum, was inferred by Sir David Brewster from some experiments, of which he has given an account, contained in the Report of the seventh meeting of the British Association. The author states the results of his own observations of similar phenomena, and their theoretical explanation on the undulatory theory, together with the mathematical development of that explanation.

3. On the Ferrosesquicyanuret of Potassium. By Alfred Smee, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author examines, in this paper, the action of chlorine upon the ferrocyanate of potassa, and the conversion of the latter into ferrosesquicyanuret; and proposes methods for obtaining this latter salt uncontaminated with impurities, and free from the difficulties and inconvenience attendant on the present mode of preparation.

4. On the influence of Iodine in rendering several argentine compounds, spread on paper, sensitive to light; and on a new Method of producing, with greater distinctness, the Photogenic Image. By Mr. Robert Hunt. Communicated by Sir John Herschel, Bart., V.P.R.S.

This paper contains various details of the results of a great number of experiments made with a view of rendering paper capable of being employed instead of metallic plates, in Daguerre's photographic process. It is accompanied with 12 papers as specimens.

5. Hourly Observations of the Barometer and Thermometer at sea, on the 21st of March, 1840. By Major-General A. Lindsay, H.E.I.C.S. Communicated by Sir John F. W. Herschel, Bart., V.P.R.S.

These observations were made on board the ship Owen Glendower, on her voyage from Calcutta to London.

6. On the Constitution of Pigotite, and on the Mudesous and Mudesic Acids. By James F. W. Johnston, Esq., M.A., F.R.S.

In this paper the author describes a substance, found by himself

and by the Rev. M. Pigot, forming an incrustation on the sides of certain caves, occurring in the granitic cliffs on the east and west coast of Cornwall. This incrustation is in mass of a brown, and in powder of a yellow colour; is insoluble in water and alcohol; when heated, it gives off much water, blackens, yields empyreumatic products, and leaves a black mass, having occasionally the lustre of graphite. In the air, at a bright red heat, this mass very slowly burns, leaving a grey or white ash, which consists of alumina, with some slight foreign admixtures.

The organic constituent of this substance (pigotite), the author considers to be derived from the decay of the various plants which grow on the moist moorlands above, and which, being carried by the waters into the fissures of the granite beneath, combines with the alumina of the decomposed felspar; and when it reaches the air, deposits itself on the roof and sides of the caverns, in the form of layers, varying from a line to two or three inches in thickness. With reference to its supposed origin, the author has given to the organic constituent the name of *mudesous* acid (from μυδησις, signifying decay through excess of moisture), and he mentions an observation, communicated to him by Dr. Bouse, that the roots of the sea pink (*Statice armeria*) contain a colouring matter resembling, *in appearance*, the solutions of the mudesous acid.

From numerous experiments and analyses detailed at length in his paper, the author derives the following general results:

1. That the native pigotite contains a dark-brown soluble, not deliquescent acid of vegetable origin, which, in the anhydrous state, is represented by $C_{12}\,H_5\,O_8$.

2. That this acid, the *mudesous*, is tribasic, the salt of silver (mudesite), being represented by $(3\,A_9\,O + C_{12}\,H_5\,O_8)$, and precipitates the salts of the metallic oxides of a brown colour.

3. That the native mudesite of alumina (Pigotite) is represented as follows:

a. Dried in the air by $(4\,\underline{\dddot{Al}} + C_{12}\,H_5\,O_8 + 27\,H\,O)$.

b. Dried at 212° F. by $(4\,\underline{\dddot{Al}} + C_{12}\,H_5\,O_8 + 8\,H\,O)$, losing 27 per cent. of water.

c. Dried at 300° F. by $(4\,\underline{\dddot{Al}} + C_{12}\,H_5\,O_8 + 8\,H\,O)$, losing 32 per cent. of water.

4. That this native mudesite, however, is more probably a compound of the organic tribasic salt, with a hydrate of alumina, and may be rationally represented thus:

a. Dried in the air by $(\underline{\dddot{Al}} + C_{12}H_5O_8 + {}_9HO) + 3\,(\underline{\dddot{Al}} + 6HO)$.

b. Dried at 212° F. by $(\underline{\dddot{Al}} + C_{12}H_5O_8 + 4HO) + 3\,(\underline{\dddot{Al}} + 2HO)$.

c. Dried at 300° F. by $(\underline{\dddot{Al}} + C_{12}H_5O_8 + 2HO) + 3\,(\underline{\dddot{Al}} + 2HO)$.

5. That when treated with nitric acid, the native mudesite, as

well as the mudesous acid itself, are oxidized and converted into a new brownish-yellow, soluble and deliquescent acid, containing more oxygen, and in the anhydrous state represented by $C_{12} H_5 O_{10}$.

6. That this new acid, the *mudesic*, combines readily with alumina and protoxide of mercury, giving salts of a yellow colour. Both the acids described in this paper are distinguished for their tendency to precipitate alumina and the protoxide of mercury. The mudesate of mercury dried at 300° F., is represented by $(2 H_9 O + C_{12} H_5 O_{10})$.

7. That chlorine, when made to act on either of the acids, or their salts of alumina in contact with water, gradually deprives them of all colour, while, at the same time, muriatic acid is formed. Collected on the filter, boiled in water till the washings cease to precipitate nitrate of silver, and dried, the white gelatinous, apparently altered mudesite or mudesate, is found on analysis to contain no atomic proportion of chlorine, but to have sensibly the constitution of the mudesic acid, or mudesates prepared by the direct action of nitric acid. The author thinks it not unlikely that a chloro-mudesic acid exists, and may be formed during this process, represented probably by $C_{12} H_4 Cl O_{10}$, but which he has not succeeded in obtaining in a separate state.

The mudesous and mudesic acids are distinguished from each other by giving, the former brown, and the latter yellow precipitates with the neutral metallic salts—by being the former unaltered, and the latter deliquescent in the air. Both form deliquescent salts with ammonia, and appear to undergo alteration by the long-continued action of hydrosulphuric, or of concentrated sulphuric and hydrofluoric acids.

7. On the Constitution of the Resins, Part V. By James F. W. Johnston, Esq., M.A., F.R.S.

In this paper the author continues his examination of what are called the fetid resins, and from repeated analyses deduces for the resin of Sagapenum the formula $C_{40} H_{29} O_9$, and for that of Galbanum $C_{40} H_{27} O_7$. He then compares the formulæ for the four resins:

Opoponax $= C_{40} H_{25} O_{14}$, Assafœtida $= C_{40} H_{26} O_{10}$,
Galbanum $= C_{40} H_{27} O_{70}$, Sagapenum $= C_{40} H_{29} O_9$;

and considers it probable that, though no striking analogy among the *irrational* formulæ for these resins is perceptible, by which their analogy in physical properties can be accounted for, that they may possess an analogous *rational* constitution, which future researches may disclose.

Euphorbium consists of two resins, of which the more soluble, A, gave the formula $C_{40} H_{31} O_6$. Elemi also consists of two resins, of which the more soluble, A, is represented by $C_{40} H_{32} O_4$, and the less soluble, B, by $C_{40} H_{32} O_1$, as had previously been shown by Hess and Rose. The Bdellium of commerce contains much gum, and a resin $C_{40} H_{31} O_5$.

The resin of Benzoin presented peculiar difficulties when submitted to investigation, from the ease with which it undergoes de-

composition, even at temperatures much below that at which it melts. With regard to this resin, the author gives the following as the result of his numerous analyses:—

1. That the colourless resin of benzoin is represented approximately by $C_{40} H_{22} O_9$.

2. That by heat and dilute carbonated alkalies it is decomposed into water, benzoic acid, a little volatile oil, and a resin $C_{40} H_{23} O_9$, or $C_{40} H_{24} O_9$.

3. That by boiling with quicklime, or concentrated carbonated alkalies, it gives two resins, one in large quantity $= C_{40} H_{24} O_8$; and another in small quantity $= C_{40} H_{30} O_7$.

4. That by caustic potash the crude resin is resolved into two resins represented respectively by $C_{40} H_{22} O_9$, and $C_{40} H_{30} O_7$, of which the former is precipitated, and the latter remains in solution, when a saturated aqueous solution of caustic potash is added to an alcoholic solution of the crude resin.

5. And that by oxide of lead two resins are separated, for which analysis gave respectively the formulæ $C_{40} H_{22} O_9$ and $C_{40} H_{26} O_{10}$.

The author concludes by stating that such metamorphoses are by no means confined to this resin, though the more accurate knowledge of their nature, obtained by the imperfect study he has made of the resin of benzoin, has explained many anomalies he had previously observed, with regard to the relations of the resins to the alkalies and metallic oxides. He considers the group of which dragon's blood is the type, and which he represents by the expression $C_{40} H_{24} \pm x O_9$ to be peculiarly susceptible of modification (or decomposition?) by the action of bases; and he specifies among other results, with regard to which it is his intention to address the Society in a future paper, that dragon's blood, of which the lump variety $= C_{40} H_{21} O_8$, and the drop variety (heated to 300° F.) $= C_{40} H_{20} O_8$, gives by the action of quicklime and oxide of lead, among other products, two resins represented approximately by $C_{40} H_{20} O_{10}$ and $C_{40} H_{20} O_{12}$?—that guiacum $= C_{40} H_{23} O_{10}$, with oxide of lead, gives a resin $= C_{40} H_{21} O_{11}$, the resin of jalap $= C_{40} H_{34} O_{18}$; by the action of the same oxide, a resin $= C_{40} H_{34} O_{20}$, and that of assafœtida $= C_{40} H_{26} O_{10}$, a new resin $= C_{40} H_{23} O_{13}$. These metamorphoses lead to the second great branch of inquiry respecting the nature and constitution of the resins. Certain results being established, at least approximately, with regard to the *irrational* constitution of the resins, and certain general irrational formulæ by which to express it, we are prepared for the study of their *rational* constitution. This part of the subject the author proposes to consider farther in subsequent communications.

8. Researches on the Tides. Twelfth Series. On the Laws of the Rise and Fall of the Sea's surface during each tide. By the Rev. W. Whewell, B.D., F.R.S., Fellow of Trinity College, Cambridge.

The materials of the present investigation are five months' tide observations made at Plymouth; three months observations made

at Liverpool, under the direction of Captain Denham, R.N.; and twelve months' observations made at Bristol, by Mr. Bunt, by means of his tide-gauge. According to the theory of the tides, the height of the surface of the water at a given place will increase as the sine, while the time increases as the arc. Hence if the time be made the abscissa, and the height the ordinate, the curve representing one tide would be the *figure of signs*. The author on making the comparison of the empirical curve of the rise and fall of the water, deduced from observation, with this theoretical curve, finds a general agreement between them; subject to certain deviations, consisting principally in the empirical curve indicating that both the rise and the fall are not symmetrical, like the theoretical curve, in consequence of the fall being generally more rapid than the rise, and thus occasioning a displacement of the summit of the curve towards that branch of it which corresponds to the fall.

9. Researches in Embryology. Third Series.—Additional Observations. By Martin Barry, M.D., F.R.S.

Having in the paper to which the present is supplementary made known the fact that the germinal spot in the mammiferous ovum resolves itself into cells, with which the germinal vesicle becomes filled, the author has since directed his attention to the corresponding parts in the ova of birds, batrachian reptiles, and osseous fishes, which he finds to be the seat of precisely the same changes. The numerous spots in the germinal vesicle of batrachian reptiles and osseous fishes are no other than the nuclei of cells. The cells themselves, from their transparency, are at first not easily discerned, and appear to have hitherto escaped notice; but after the observer has become aware of their presence, they are, in many instances, seen to be arranged in the same manner, and to present the same interior themselves as the corresponding cells in the ovum of mammalia.

In the representations given by Professor Rudolph Wagner, the discoverer of the germinal spot, the author recognizes evidence of the same changes in ova throughout the animal kingdom. He confirms and explains the observations of R. Wagner, that in the ova of certain animals an originally single spot divides into many, and that in the ova of other animals the number of spots increases as the ovum ripens. But he expresses also the opinion that in all ova there is originally but a single spot, this being the nucleus of the germinal vesicle or cell.

The analogy between the ova of mammalia and the animal abovementioned, extends also to the substance surrounding the germinal vesicle, which consists of nucleated cells.

10. Description of a Calculating Machine invented by Mr. Thomas Fowler, of Torrington in Devonshire. By Augustus De Morgan, Esq. Communicated by F. Baily, Esq., V.P.R.S.

The arithmetical operations performed by the machine are those of multiplication and division; the factors and product in the former case, and the quotient, dividend and divisor in the latter, being

expressed in digits of the ternary scale of notation, every digit being either $-1, 0$, or $+1$. In this system, unity being, in multiplication, only an index, the rules for multiplication and division must consist entirely in directions for the management of the signs of unity; and it is on this principle that Mr. Fowler's machine is made to act. A short account is given of the principal parts of the machine, and of the mode in which they bring out the final results. It is necessary, however, in applying it to use, to have recourse to tables, both for converting the factors and reconverting the result; operations which introduce both labour and risk of error.

11. On the Minute Structure and Movements of Voluntary Muscles, in a letter addressed to R. B. Todd, M.D., F.R.S., &c. By William Bowman, Esq., Demonstrator of Anatomy in King's College, London, and Assistant Surgeon to King's College Hospital. Communicated by Dr. Todd.

The objects of the author, in this paper, are the following.—1st. To confirm, under some modifications, the view taken of the primitive fasciculi of voluntary muscles being composed of a solid bundle of fibrillæ. 2dly. To describe new parts entering into their composition: and 3dly. To detail new observations on the mechanism of voluntary motion.

He first shows that the primitive fasciculi are not cylindrical, but polygonal threads; their sides being more or less flattened where they are in contact with one another; he next records, in a tabular form, the results of his examination of their size in the different divisions of the animal kingdom. It appears that the largest are met with in fish; they are smaller in reptiles, and their size continues to diminish in insects, in mammalia, and lastly, in birds, where they are the smallest of all. In all these instances, however, an extensive range of size is observable, not only in different species, but in the same animal, and even in the same muscle. He then shows that all the fibrillæ into which a primitive fasciculus may be split, are marked by alternate dark and light points, and that fibrillæ of this description exist throughout the whole thickness of the fasciculus; that the apposition of the segments of contiguous fibrillæ, so marked, must form transverse striæ, and that such transverse striæ do in fact exist throughout the whole interior of the fasciculus. He next inquires into the form of the segments composing the fibrillæ, and shows that their longitudinal adhesion constitutes *fibrillæ*, and their lateral adhesion *discs*, or plates, transverse to the length of the fasciculus; each disc being, therefore, composed of a single segment from every one of the fibrillæ. He shows that these discs always exist quite as unequivocally as the fibrillæ, and gives several examples and figures of a natural cleavage of the fasciculus into such discs. It follows that the transverse striæ are the edges, or focal sections of these discs. Several varieties in the striæ are then detailed, and the fact noticed that in all animals there is frequently more or less diversity in the number of striæ in a given space, not only on contiguous fasciculi, but also on the same fasciculus at different parts.

The author then proceeds to describe a tubular membranaceous sheath, of the most exquisite delicacy and transparency, investing each fasciculus from end to end, and isolating it from all other parts; this sheath he terms *Sarcolemma*. Its existence and properties are shown by several modes of demonstration; and among others, by a specimen in which it is seen filled with parasitic worms (Trichinæ), which have removed all the fibrillæ. The adhesion of this sarcolemma to the outermost fibrillæ is explained.

It is also shown that there exist in all voluntary muscles a number of minute *corpuscles* of definite form, which appear to be identical with, or at least analogous to the nuclei of the cells from which the development of the fasciculi has originally proceeded. These are shown to be analogous to similar bodies in the muscles of organic life, and in other organic structures.

The author next describes his observations on the mode of union between tendon and muscle; that is, on the extremities of the primitive fasciculi. He shows that in fish and insects the tendinous fibrillæ become sometimes directly continuous with the extremities of the fasciculi, which are not taper, but have a perfect terminal disc. In other cases the extremities are shown to be obliquely truncated, where the fasciculi are attached to surfaces not at right angles to their direction.

Lastly. He states his opinion, and gives new facts on which it is founded, that in muscular contraction the discs of the fasciculi become approximated, flattened, and expanded; the fasciculi, of course, at the same time becoming shorter and thicker. He considers that in all contractions these phenomena occur; and he adduces arguments to show the improbability of the existence of any rugæ or zigzags as a condition of contracting fasciculi in the living body. The paper is abundantly illustrated by drawings of microscopic appearances.

The Society then adjourned over the long vacation, to meet again on the 19th of November next.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1840. No. 45.

November 19, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Edward Kater, Esq., was balloted for, and duly elected a Fellow of the Society.

A paper was read, entitled, Supplement to a paper "On the Theoretical Explanation of an apparent new Polarity in Light;" by George B. Airy, Esq., M.A., F.R.S., Astronomer Royal.

In a paper published in the second part of the Philosophical Transactions for 1840, the author explained, on the undulatory theory of light, the phenomena observed by Sir David Brewster, and apparently indicating a new polarity in light. That explanation was founded on the assumption that the spectrum was viewed out of focus; an assumption which corresponded with the observation of the author and of other persons. But the author having, since the publication of that memoir, been assured by Sir David Brewster that the phenomenon was most certainly observed with great distinctness when the spectrum was viewed so accurately in focus that many of Frauenhofer's finer lines could be seen, he has continued the theoretical investigation for that case, which had been omitted in the former memoir, namely, when the spectrum is viewed in focus; and he has arrived at a result, which appears completely to reconcile the seemingly conflicting statements, and to dispel the obscurity in which the subject had hitherto been enveloped.

November 26, 1840.

Sir JOHN BARROW, Bart., Vice-President, in the Chair.

The following gentlemen were, by ballot, elected Auditors of the Treasurer's Accounts, on the part of the Society, viz. William Thomas Brande, Esq.; Richard Bright, M.D.; William Henry Fitton, M.D.; Lieut.-Colonel William Henry Sykes; and the Rev. Robert Willis, M.A.

Charles Dickson Archibald, Esq., and William Robert Grove, Esq., were balloted for, and duly elected Fellows of the Society.

The following papers were read:—

1.—Description of a Percussion Shell to explode at the bottom of the Sea. By Captain J. Norton. Communicated by S. Hunter Christie, Esq., M.A., Sec. R.S., &c.

An iron tube, like the barrel of a musket, is screwed into a shell of any size, water-tight. A rod of iron, about half a pound in weight and a foot in length, is suspended within the tube, by means of a split quill passing through a hole in the upper end of the rod, the other end being armed with a percussion-cap. The mouth of the tube is closed with a screw lid also water-tight. Tin or brass wings being attached to the upper end of the tube will keep it in a vertical position during its descent to the bottom of the sea; and the shock on its striking the bottom will cause the bar of iron within the tube to fall, and produce the percussion and explosion.

Should it be found difficult to make the shell water-proof, I am satisfied that percussion powder made from silver will explode by friction or percussion even when *mixed with water*.

2.—Memorandum addressed to the Royal Society. By T. Wharton Jones, F.R.S.

The following is the memorandum in the words of the author:—

On the 18th of June, 1835, a memoir, entitled, "On the Ova of Man and Mammiferous Animals, as they exist in the Ovaries before Impregnation, and on the discovery in them of a Vesicle analogous to that described by Professor Purkinje in the Immature Egg of the Bird," was laid before the Royal Society.

At the time I wrote, I believed myself the first who had observed the vesicle alluded to; but by a reference to the manuscript in the archives of the Society, it will be seen, from a postscript, that before sending it to be communicated, I had become aware that M. Coste of Paris had some time before announced that he had made a similar observation, as far as concerns the rabbit. Those who are conversant in such matters are doubtless aware that I was anticipated also by Professor Valentin; but of this circumstance I was not informed till some considerable time after.

It thus appears that, though I was an independent discoverer of the germinal vesicle of the mammiferous ovum, all the share in the discovery I can lay claim to *historically* is that of being the first who pointed it out in this country.

There is one point, however, in the anatomy of the germinal vesicle of the mammiferous ovum of which I feel myself entitled to be recognized, especially by the Royal Society, as contemporaneous discoverer, and that is, the spot on the side of the vesicle. Feeling this, and having heard at the last meeting of the Royal Society the discovery of this spot attributed solely to the distinguished German

physiologist, Professor Rudolph Wagner, I consider it due to the Royal Society and to myself to call to the Society's remembrance the fact, that, in the memoir above referred to as having been laid before them in 1835, the spot in question is not only pointed out and particularly delineated, but its physiological importance hinted at.

The laying of a paper before a Society is an act of publication. With the communication of my paper to the Royal Society in 1835, the publication of Professor Wagner's paper in Müller's Archiv was *contemporaneous* merely.

It is true, that though Professor Wagner's observations were only first published in Müller's Archiv for 1835, there is a note by the editor, saying that the paper was received by him in 1834; but it is also true,—and of this, were it necessary, proof could be easily adduced,—that my paper was written also in 1834.

In conclusion, I beg to apologize to the Royal Society for obtruding on their notice what may appear matter rather of personal than general interest.

3.—Description of the Electro-magnetic Clock. By C. Wheatstone, Esq., F.R.S.

The object of the apparatus forming the subject of this communication, is stated by the author to be that of enabling a single clock to indicate exactly the same time in as many different places, distant from each other, as may be required. Thus, in an astronomical observatory, every room may be furnished with an instrument, simple in its construction, and therefore little liable to derangement, and of trifling cost, which shall indicate the time, and beat dead seconds audibly, with the same precision as the standard astronomical clock with which it is connected; thus obviating the necessity of having several clocks, and diminishing the trouble of winding up and regulating them separately. In like manner, in public offices and large establishments, one good clock will serve the purpose of indicating the precise time in every part of the building where it may be required, and an accuracy ensured which it would be difficult to obtain by independent clocks, even putting the difference of cost out of consideration. Other cases in which the invention might be advantageously employed were also mentioned. In the electro-magnetic clock, which was exhibited in action in the Apartments of the Society, all the parts employed in a clock for maintaining and regulating the power are entirely dispensed with. It consists simply of a face with its second, minute and hour hands, and of a train of wheels which communicate motion from the arbor of the second's hand to that of the hour hand, in the same manner as in an ordinary clock train; a small electro-magnet is caused to act upon a peculiarly constructed wheel (scarcely capable of being described without a figure) placed on the second's arbor, in such manner that whenever the temporary magnetism is either produced or destroyed, the wheel, and consequently the second's hand, advances a sixtieth part of its revolution. It is obvious, then, that if an electric current can be alternately established and arrested, each resumption and cessation

lasting for a second, the instrument now described, although unprovided with any internal maintaining or regulating power, would perform all the usual functions of a perfect clock. The manner in which this apparatus is applied to the clocks, so that the movements of the hands of both may be perfectly simultaneous, is the following. On the axis which carries the scape-wheel of the primary clock a small disc of brass is fixed, which is first divided on its circumference into sixty equal parts; each alternate division is then cut out and filled with a piece of wood, so that the circumference consists of thirty regular alternations of wood and metal. An extremely light brass spring, which is screwed to a block of ivory or hard wood, and which has no connexion with the metallic parts of the clock, rests by its free end on the circumference of the disc. A copper wire is fastened to the fixed end of the spring, and proceeds to one end of the wire of the electro-magnet; while another wire attached to the clock-frame is continued until it joins the other end of that of the same electro-magnet. A constant voltaic battery, consisting of a few elements of very small dimensions, is interposed in any part of the circuit. By this arrangement the circuit is periodically made and broken, in consequence of the spring resting for one second on a metal division, and the next second on a wooden division. The circuit may be extended to any length; and any number of electro-magnetic instruments may be thus brought into sympathetic action with the standard clock. It is only necessary to observe, that the force of the battery and the proportion between the resistances of the electro-magnetic coils and those of the other parts of the circuit, must, in order to produce the maximum effect with the least expenditure of power, be varied to suit each particular case.

In the concluding part of the paper the author points out several other and very different methods of effecting the same purpose; and in particular one in which Faraday's magneto-electric currents are employed, instead of the current produced by a voltaic battery: he also describes a modification of the sympathetic instrument, calculated to enable it to act at great distances with a weaker electric current than if it were constructed on the plan first described.

November 30, 1840.

At the Anniversary Meeting, the Marquis of Northampton, President, in the Chair,

Lieut.-Colonel William Henry Sykes, on the part of the Auditors of the Treasurer's Accounts, reported that the total receipts during the last year, inclusive of a balance of 1808*l.* 9*s.* 7*d.*, carried from the account of the preceding year, amounted to 5725*l.* 8*s.* 10*d.*: that the total payments in the same period amounted to 4787*l.* 9*s.* 3*d.*, leaving a balance in the hands of the Treasurer of 937*l.* 19*s.* 7*d.*

The Thanks of the Meeting were given to the Auditors for the trouble they had taken in examining the Treasurer's Accounts.

The Treasurer reported the numerical state of the Society.

The Thanks of the Meeting were voted to the Treasurer.

The Secretary read the following list of deceased Fellows of the Royal Society since the last Anniversary in 1839; of those withdrawn; and of Fellows admitted into the Royal Society since the last Anniversary.

List of Fellows of the Royal Society deceased since the last Anniversary (1839).

On the Home List.

Lord Arden.
George Simon Borlase, Esq.
Sir Anthony Carlisle, Knt.
Lord Henry John S. Churchill.
Rev. Alexander Crombie, LL.D.
Earl Ducie.
Lord Garvagh.
Davies Gilbert, Esq.
Lewis Alexander Grant, Esq.
Alexander Hay, M.D.
Lord Holland.
Alexander Copland Hutchinson, Esq.
Thomas Leybourn, Esq.
The Bishop of Lichfield and Coventry.
Sir John William Lubbock, Bart.
Rev. Francis Lunn, B.A.
Simon MacGillivray, Esq.
The Earl of Mansfield.
The Earl of Morley.
Captain Charles Phillips, R.N.
James Prinsep, Esq.
Rev. Thomas Rackett, M.A.
John Rickman, Esq.
John Rogerson, M.D.
Sir Robert Seppings, Knt.
Captain Matthew Smith, R.N.
Admiral Sir William Sidney Smith, K.C.B.
Major-General Sir Joseph Stratton, Knt. C.B.
Nicholas Aylward Vigors, Esq., M.P.
Sir Jeffrey Wyattville, Knt.

On the Foreign List.

J. F. Blumenbach, of Göttingen.
Wilhelm Olbers, of Bremen.
Le Baron Poisson, of Paris.

Withdrawn from the Society.

The Earl of Tyrconnel.

List of Admissions into the Royal Society since the last Anniversary (1839).

On the Home List.

His Royal Highness Prince Albert, K.G.
James Annesley, Esq.
John Auldjo, Esq.
Martin Barry, M.D.
John Theophilus Boileau, Esq., Captain in the E.I.C.S.
Lieut.-Colonel John George Bonner, E.I.C.S.
William Burge, Esq.
John Caldecott, Esq.
Thomas Cook, Esq., Lieut. R.N.
Henry Drummond, Esq.
Walter Ewer, Esq.
John P. Gassiot, Esq.
Thomas Tassal Grant, Esq.
Thomas Henderson, Esq.
William Jory Henwood, Esq.

William Hutton, Esq.
John Gwyn Jefferys, Esq.
Thomas Wharton Jones, Esq.
Edward Kater, Esq.
Henry Lawson, Esq.
Lord Lyttleton.
John Grant Malcolmson, M.D.
John Narrien, Esq.
The Bishop of Norwich.
John Parkinson, Esq.
Joseph Phillimore, LL.D.
Rev. Charles Pritchard, M.A.
The Duke of Richmond.
John Rogers, Jun., Esq.
George Leith Roupell, M.D.
William Sharp, Esq.
John Pye Smith, D.D.
James Whatman, Jun., Esq.

On the Foreign List.

Jean Baptiste Dumas.
Justus Liebig.
Johannes Müller.
Jacques Charles François Sturm.

The President then addressed the Meeting as follows:

GENTLEMEN,

In addressing you at the termination of this, the second year that I have had the honour of presiding over your Society, my first duty is to return my thanks to those gentlemen whom you have nominated to be my Council. They have rendered an onerous duty comparatively light and easy by their unremitting attendance and zeal; and have, as I trust, prevented your affairs from suffering from any incompetency on my part. In making my report of the transactions of the last year, I know of nothing to regret, except the loss of some of our valued Associates, who between the end of last November and the present time have paid the debt of nature.

Among the new members enrolled in our body, it will perhaps be right to mention the name of the Bishop of Norwich, as being President of the Linnean Society, one of the oldest branches that may be considered as thrown off from our parent stem. Also that of the Duke of Richmond, as President of the two newest Associations founded for the promotion of science, the Royal Agricultural and Botanical Societies. We have one new member of still higher rank, who has honoured us by becoming one of our Fellows, H. R. H. Prince Albert, the consort of our beloved Queen and Patroness. As your organ, Gentlemen, I will venture to say that you duly appreciate the honour conferred on yourselves; at the same time while His Royal Highness gratifies us by joining our body, we entertain no doubt that he does so from the just conviction that the patronage and advancement of science are national objects of the deepest importance.

The Antarctic Expedition, to whose departure I adverted in my last year's Address is, I trust, now successfully pursuing its career of scientific research. Already a portion of the fruits of its labours has reached us, and promises an abundant and valuable harvest. The fixed Magnetic Observatories on the territories of Her Majesty are now also in full operation; while foreign powers have given us

the assistance of observations made at the same instant of time, and on the same system as our own. I have the satisfaction to state, that these observatories exceed forty in number.

While these researches are being made by our own and other states, private enterprise is not idle. Mr. Enderby, to whom geography is already indebted, has sent out a vessel for the purposes of discovery in the Antarctic seas, with the object of approaching as near as may be to the Southern pole. His ship is navigated by Mr. Mapleton, an officer who had been selected by Her Majesty's Government to take a part in Captain Ross's expedition; but he had not returned to England before that expedition had sailed. We may well hope that he will merit this double confidence, and that he will, if his life be spared, add another wreath to the laurels of England, won by a Parry and a Ross, a Cooke and a Vancouver.

You are aware, Gentlemen, that previously to the departure of the late expedition, the Council of the Royal Society was requested by the government to draw up a statement of the most desirable objects in science to which the attention of the officers employed might be directed. With this request, as you might also know, the Council immediately complied; and in the execution of the duty thus devolved on us, the assistance of the Scientific Committees was our principal means of success. Since that time it has occurred to us, that the same recommendations, in rather a different shape, might be of great use to other scientific travellers. We have accordingly taken considerable pains in perfecting these suggestions, which we have caused to be printed for the public in general. We have already furnished copies to the Commander of the Expedition to the Niger, and I hope that, in addition to his higher objects, he may be enabled to promote our acquaintance with the details of the geography and natural history of those imperfectly known parts of the globe.

I have the satisfaction to inform you, that by desire of the Council Mr. Shuckard has completed a Catalogue of the valuable manuscript letters in our library, among which are many from Ray, Willoughby, Newton, Boyle, Hook, and other eminent men, which we trust may serve as a useful aid to those Fellows who may wish to consult documents of so much interest and value.

You will also be glad to know that Mr. Halliwell, one of our Fellows, has undertaken and executed the task of making a catalogue of the miscellaneous manuscripts in our library; a labour for which I am sure you will feel much indebted to the author. In this collection the Society possesses one most valuable manuscript, the *Principia* in the hand-writing of the immortal Newton.

The Royal Society, Gentlemen, was founded for the advancement of natural knowledge, not for any purposes of private advantage or vain glory. It must, therefore, always hail the foundation and prosperity of new bodies of scientific men, brought together by the same object in particular branches of science, either in the abstract, or connected with important arts and manufactures. It cannot but rejoice, therefore, at the continued prosperity of the British Associ-

ation, and in the formation of new societies for Microscopical Research, and for the improvement of Botany and Agriculture.

With respect to the last of these, we must look with satisfaction to every effort to carry the torch of science, to light up the intricacies and doubts of an art, the first probably in age, and certainly the first in importance to civilized man. As to the Botanical Society, we cannot but be glad that the want of a public and national Garden should be in some measure supplied, and we may indulge a hope that the example may, at a future time, lead our Government to provide an establishment commensurate with the wealth of Great Britain, with the magnitude of the metropolis, and with the extensive colonial empire from which it might be supplied with the productions of the most varied climates.

With the continued and increasing prosperity of the British Association, I may the more boldly call on you to sympathize, as the greater part of its most active and talented members are also among the most valued of our own Fellows. It had this year a great additional merit in the very numerous attendance of the scientific natives of other countries, and it gave to those among us who were present at Glasgow the opportunity of becoming personally acquainted with some of our Foreign Members; with an Encke, and an Agassiz. The latter gentleman, having fortunately extended his visit to England, we have now the pleasure of seeing him at our Anniversary; a pleasure that we should have probably lost, had he not been attracted by the meeting of the British Association.

During the last year we have had more than one occasion of testifying our grateful and loyal attachment to our Royal Patroness. Another now presents itself, which I am sure you will gladly seize, to express our joy at the birth of a Princess, our gratitude to Heaven for our Sovereign's safety, and our fervent prayers for her long and prosperous reign over the hearts as well as persons of her subjects.

Since we last assembled our room of meeting has been ornamented, as you will see, Gentlemen, by the portrait of our late Royal President, from the pencil of Mr. Phillips. I am sure that you will be gratified by this addition to the likenesses of the far greater number of my predecessors. Future successors of the present Fellows of the Royal Society will look with satisfaction at the striking representation of a Prince, who has added to the many favours received by us from his illustrious house, that of deigning to preside over our Meetings and our Councils.

Of the papers that have been read at our Meetings, it is not necessary for me to speak. Of their merits you will be enabled to judge in a considerable degree by the Abstracts contained in our printed Proceedings; while those that have appeared to the Council, assisted by the Scientific Committees, to be of the most importance, will be found in the Philosophical Transactions. As a new proof of which I cannot, however, refrain from adverting for a moment to one topic,—the discovery of Photography, for which we are indebted to a Neipce, a Daguerre, and a Talbot; and which not only promises important results to art, but valuable assistance also, by the applica-

tion of an Ibbotson and others, to those branches of knowledge which are connected with organic matter. This is, however, not all. Through the interesting observations of Sir J. Herschel and Mr. Hunt, followed up, as they will doubtless be, by other philosophers, a vista seems to open into hitherto unexplored regions of science.

I have the honour, Gentlemen, to inform you that the Council have awarded the Royal Medals for the present year to Sir John F. W. Herschel and Professor Wheatstone; one Copley Medal to Professor Liebig, and another to M. Sturm; and the Rumford Medal to M. Biot.

Sir John Lubbock.

It is to me a cause of the highest satisfaction that I have to present through you this Royal Medal to Sir John F. W. Herschel, being the fourth Medal that has been awarded to him by the decision of different Councils.

It is to myself and to the other Members of the Council a most gratifying circumstance, that in an invention of great interest to art, he has found an instrument capable of making us acquainted with most curious laws regulating the chemical action of the different rays of the spectrum on the same substances. They have an additional interest to us as well as to you, in reminding us of researches made by the honoured parent whose example of scientific zeal he so well emulates. The observations that Sir J. Herschel has made in his recent communication, appear likely to lead to new discoveries in optical as well as chemical science; and we trust that the papers already before us may be the forerunners of still more striking and important results.

Professor Wheatstone.

It is with great pleasure that I address you, and present to you one of those Medals that our Royal Patroness has placed at the disposal of the Council of our Society. Your valuable experiments, and the ingenious methods by which you have solved the difficult question of Double Vision, form the immediate, and certainly sufficient motive, for their adjudication. It is, however, still more satisfactory, as it gives me, as their organ, the opportunity to mark their sense of the value of your other discoveries, of the science and ingenuity by which you have measured Electrical Velocity, and by which you have also turned your acquaintance with Galvanism to the most important practical purposes.

Professor Daniell.

In confiding to your charge, as our Foreign Secretary, the Rumford Medal which the Council has awarded to M. Biot, I am sure that every cultivator of the higher and more abstruse branches of science will feel that it is bestowed on a philosopher, whose optical researches on the curious and interesting subject of Polarized Light are of the highest value. You may, at the same time that you forward the Medal, assure M. Biot of the anxious wish of the Royal

Society that he may be long enabled to carry on inquiries so honourable to himself, and so important to more than one branch of science.

Professor Daniell, I hold in my hand, and deliver to you one of the Copley Medals, which has been awarded by us to Professor Liebig. My principal difficulty, in the present exercise of this the most agreeable part of my official duty, is to know whether to consider M. Liebig's inquiries as most important in a chemical or in a physiological light. However that may be, he has a double claim on the scientific world, enhanced by the practical and useful ends to which he has turned his discoveries. I hope that he may long be able to follow at the same time the paths of scientific research and practical utility.

Professor Daniell, I have again to call on you, in your official capacity, to transmit a Medal to the Continent. The gentleman to whom we have adjudged it is M. Sturm, for his valuable mathematical labours, the fruits of which must be important, not only to mathematics, but also to those other high and abstruse sciences to whose advancement algebraical analysis is a necessary instrument. In his solution, therefore, of a problem which has baffled some of the greatest mathematicians that the world has produced, he has well earned the gratitude of every lover of natural knowledge.

You will, Gentlemen, hear read an account of the eminent men connected with our Society whom we have had the misfortune to lose since last November. Having confided the task of enumerating them to one of your Members, more able than myself to do justice to their merits, I shall not further touch upon the subject than to express my deep regret at the decease of one who had been my predecessor in this Chair, and to whose counsel I might have looked for aid in any conjuncture of difficulty, with full reliance on his good sense and ability, and also on his zeal in any matter in which the interests of the Royal Society were at stake. I may also be permitted to express the condolence of all the Members of the Royal Society with the domestic affliction of our valued Treasurer by the decease of his father, who was also one of our Fellows. I will now desire Dr. Roget to read the account of those whom we now miss from our ranks.

The first name in the list of our deceased Fellows, which it is my melancholy duty to notice, is one which cannot be mentioned in this room, without feelings of deep regret for the loss of his services and of affectionate respect for his many virtues: it is hardly necessary for me to add that I refer to our late associate and former President, Mr. Davies Gilbert.

He was the only surviving son of the Rev. Edward Giddy, of St. Erth in Cornwall, and his mother, whose maiden name was Davies, was the representative of several ancient and distinguished families in that county, and the heiress likewise of very considerable property. His early education, which was almost entirely domestic, was

chiefly superintended by his father, who was an accomplished classical scholar; and in 1785 he became a gentleman commoner of Pembroke College, Oxford, where he attended the lectures of Dr. Beddoes on chemistry, Dr. Sibthorp on botany, and Mr. Hornby on geometry and astronomy, and devoted himself with very unusual diligence to the study of mathematics and the natural sciences. He used to boast in after life, with very becoming pride, that he was the first student of his class in the University of Oxford, who had ever read the Principia of Newton.

In 1791, he was elected a Fellow of this Society, and became associated from that time forward with the most eminent men of science in the metropolis. He had, in very early life, appreciated the extraordinary combination of poetical and philosophical genius in his friend and fellow-countryman Humphry Davy, at that time in a very humble capacity; and by recommending him, first, as an assistant to Dr. Beddoes in his experiments on the medical effects of gaseous inspirations, and, secondly, to the Royal Institution, he had the merit and good fortune of contributing to rescue from obscurity one of the greatest discoverers in modern chemistry. In the year 1804, he became Member of Parliament for Helston, and in 1806 for Bodmin, a borough in his own immediate neighbourhood, which he continued to represent until the era of Parliamentary Reform in 1832. He was emphatically the representative of scientific interests in the House of Commons, and contributed by his exertions to carry many very important projects, including amongst them the great breakwater at Plymouth and the bill for the revision of weights and measures; a bill founded upon the report of a commission of which he was a member, in conjunction with Captain Kater, Dr. Young and Dr. Wollaston.

Mr. Davies Gilbert was the author of Papers in our Transactions "On the Mathematical Theory of Suspension Bridges*," with particular reference to the Menai bridge, which was at that time in progress, and the curvature of which was considerably modified in conformity with the results of his calculations:—"On the Progressive Improvements made in the Efficiency of Steam-engines in Cornwall, with investigations of the methods best adapted for imparting great Angular Velocities†," in which he first distinctly defined and made known to men of science what is termed the *duty* of steam-engines, from the correct observation of which so many important practical improvements have followed:—"On the Nature of Negative and Imaginary Quantities‡," which contains many ingenious views, although they have been in a great measure superseded by later speculations on this subject. Mr. Gilbert was a mathematician of the old school; but the papers to which we have just referred are very creditable specimens of the clearness with which he apprehended the bearing of some simple theoretical truths upon very important practical questions.

* For 1826, Part III. p. 202. † For 1830, Part I. p. 121.
‡ For 1831, Part II. p. 341.

He became President of this Society in 1828, on the resignation of Sir Humphry Davy; a situation from which he retired in 1831. He continued, however, for the remainder of his life, to take a prominent part in the concerns of the Society; and there are few of my brother-Fellows, whom I have now the honour of addressing, who have not had opportunities of observing and appreciating his constant zeal for the interests of science, the variety and philosophical character of his conversation, the simple and unaffected eloquence of his public addresses, and, above all, that sweetness of temper and kindness of heart which beamed forth in the expression of those truly classical and benevolent features, which one of the most accomplished of our artists (himself a brother-Fellow) has so happily perpetuated in the portrait which adorns these walls. The very absence of that inflexibility of purpose and of opinion which some might consider essential to the perfection of the character of a philosopher, seemed, in his case, the proper developement of that natural benevolence and humanity which made him so justly beloved in every relation of life, whether as a husband, a father, and a brother, —as a master, a landlord, and a friend.

Mr. Gilbert was the author and editor of several antiquarian and other works relating to his native county, whose interests he always laboured to promote with more than common zeal and patriotism. He was President of the Cornish Geological Society from the period of its first establishment in 1814, and he never omitted attending its meetings, though on the last occasion he was so weak as to be compelled to resign the chair to his friend and countryman Sir Charles Lemon. In 1808, he married Miss Gilbert, and assumed her name in 1817, on succeeding to a very large property in Sussex. The same simple and unaffected character which distinguished him in public life was still more conspicuous in his domestic relations. He died on the 24th of December last, and his body was borne to the grave by his own labourers, and followed by his widow and family in that primitive and unostentatious form which best suited the simplicity and natural humility of his own character.

Dr. Samuel Butler, Bishop of Lichfield, was born in 1774, at Kenilworth, which was likewise the birth-place of two other contemporary prelates of our church. He was educated at Rugby, and became afterwards a member of St. John's College, Cambridge, where he gained the highest classical honours which the University could confer. In 1798 he was made Head Master of Shrewsbury School, over which he continued to preside during a period of thirty-eight years. His great acquirements as a scholar, his eminent skill as a teacher, his active interest in the welfare of his pupils, and the tact and knowledge of character which he showed in their management, all contributed to raise the school to the highest reputation, and to give it, during many years, the pre-eminence over every other school in the kingdom in the number and rank of the academical honours which were gained by his scholars. The date of his elevation to the Bench was nearly contemporaneous with the appearance of that fatal disease which, after three years of the most depressing suffer-

ings, borne with most exemplary patience and resignation, brought him to the grave. He was a man of great cheerfulness of temper and disposition, kind, affectionate and generous in every relation of life, and justly the object of the grateful attachment and love of his numerous pupils.

Dr. Butler was the author of an elaborate edition of Æschylus, with the notes and text of Stanly, and of several educational and other works. He formed a very extensive library; and his collection of Aldines, which is unhappily now dispersed, was perhaps the most complete in Europe. One of his last works was an interesting memoir of Dr. John Johnstone, of Birmingham, with whom he had long been connected by the bonds of the most affectionate friendship.

Mr. James Prinsep, whose brilliant career of research and discovery has been closed by a premature death in the flower of his age, was Principal Assay Master, first of the Mint at Benares, and secondly of that of Calcutta, where he succeeded Professor Wilson in 1833; he was a young man of great energy of character, of the most indefatigable industry, and of very extraordinary accomplishments; he was an excellent assayist and analytical chemist, and well acquainted with almost every department of physical science; a draughtsman, an engraver, an architect, and an engineer; a good Oriental scholar, and one of the most profound and learned Oriental medallists of his age.

In 1828 he communicated to our Society a paper "On the Measurement of High Temperatures," in which he described, amongst other ingenious contrivances for ascertaining the order, though not the degree, of high temperatures, an air-thermometer applicable for this purpose, and determined by means of it, probably much more accurately than heretofore, the temperature at which silver enters into fusion.

His activity whilst resident at Benares has more the air of romance than reality. He designed and built a mint and other edifices; he repaired the minarets of the great mosque of Aurengzebe, which threatened destruction to the neighbouring houses; he drained the city and made a statistical survey of it, and illustrated by his own beautiful drawings and lithographs the most remarkable objects which the city and its neighbourhood contains; he made a series of experimental researches on the depression of the wet-bulb hygrometer; he determined from his own experiments the values of the principal coins of the East, and formed tables of Indian metrology and numismatics, and of the chronology of the Indian systems and of the genealogies of Indian dynasties, which possess the highest authority and value.

When transferred to Calcutta, he became the projector and editor of the "Journal of the Asiatic Society of Bengal," a very voluminous publication, to which he contributed more than one hundred articles on a vast variety of subjects, but more particularly on Indian coins and Indian Palæography. He first succeeded in deciphering the legends which appear on the reverses of the Greek Bactrian coins,

on the ancient coins of Surat, and on those of the Hindoo princes of Lahore and their Mahomedan successors, and formed alphabets of them, by which they can now be readily perused. He traced the varieties of the Devanagari alphabet of Sanscrit on the temples and columns of Upper India to a date anterior to the third century before Christ, and was enabled to read on the rocks of Cuttock and Gujarat the names of Antiochus and Ptolemy, and the record of the intercourse of an Indian monarch with the neighbouring princes of Persia and Egypt; he ascertained that, at the period of Alexander's conquests, India was under the sway of Boudhist sovereigns and Boudhist institutions, and that the earliest monarchs of India are not associated with a Brahminical creed or dynasty. These discoveries, which throw a perfectly new and unexpected light upon Indian history and chronology, and which furnish, in fact, a satisfactory outline of the history of India, from the invasion of Alexander to that of Mohammed Ghizni, a period of fifteen centuries, are only second in interest and importance, and we may add likewise in difficulty, to those of Champollion with respect to the succession of dynasties in ancient Egypt.

These severe and incessant labours, in the enervating climate of India, though borne for many years with little apparent inconvenience or effect, finally undermined his constitution; and he was at last compelled to relinquish all his occupations, and to seek for the restoration of his health in rest and a change of scene. He arrived in England on the 9th of January last; but the powers both of his body and his mind seemed to have been altogether worn out and exhausted; and after lingering for a few months, he died on the 22nd of April last, in the forty-first year of his age. The cause of literature and archæology in the East could not have sustained a severer loss.

Sir Anthony Carlisle was born at Stillington, in the county of Durham, in the year 1768. After commencing his professional education at York, under the care of his uncle, he became a student at the Hunterian School of Anatomy, in Windmill Street, under Dr. Baillie and Mr. Cruikshank, where he attracted the particular notice of John Hunter. He subsequently became a resident pupil of Mr. Henry Watson, one of the most eminent surgeons in the metropolis, whom he succeeded at the Westminster Hospital in 1793. In 1800 he communicated to our Transactions a paper "On a Peculiarity in the Distribution of the Arteries sent to the Limbs of Slow-moving Animals." This was followed by many others on various points of comparative and human anatomy, including his papers "On Muscular Motion," and "On the Arrangement and Mechanical Action of the Muscles of Fish," which formed the Croonian Lectures for 1804 and 1806. He was the author likewise of many communications in the Transactions of the Linnean and Horticultural Societies and in other contemporary journals, on different branches of natural history and physical science.

"An Essay on the Connexion between Anatomy and the Fine

Arts," led to his appointment, in 1808, to the Professorship of Anatomy to the Royal Academy, a situation which he filled with great advantage to the students during a period of sixteen years.

Sir Anthony Carlisle was not less distinguished for his knowledge of anatomy, physiology, and natural history, than for his professional merits, and for his patience and skill as an instructor of medical students. As a practitioner, he was invariably kind and attentive to those who were entrusted to his care, and eminently liberal in devoting his professional services to those who had no adequate means of repaying them.

Mr. Nicholas Aylward Vigors was born in 1787, at Old Leighlin, in the county of Carlow, where his family had long resided. After the usual preparatory education, he proceeded to the University of Oxford, where he became a very diligent and successful student. On quitting the University, he purchased a commission in the Guards, and distinguished himself highly at the battle of Barossa, by continuing to bear the colours of his regiment after he was severely wounded. On his return from the Peninsula, he was prevailed upon, by the earnest entreaties of his family, to quit the army; and he devoted himself afterwards, with characteristic ardour, to scientific and literary pursuits.

Mr. Vigors was one of the founders and the first Secretary of the Zoological Society, to whose museum he gave his very valuable collections of ornithology and entomology, which were the two branches of natural history he had most carefully studied. He was the author of a very elaborate paper in the Linnean Transactions*, "On the Natural Affinities which connect the Orders and Families of Birds," in which he attempted to apply in detail the same principles of arrangement that Mr. MacLeay had previously sketched out in his *Horæ Entomologicæ*, in a more general way, as applicable to the whole animal kingdom. He afterwards published, in conjunction with Dr. Horsfield, another very valuable memoir† on the Birds of Australia, grounded upon a rich collection from that country, in the possession of the Linnean Society, which they described and arranged according to their natural affinities. He was likewise the principal editor, during several years, of the "Zoological Journal," in which he wrote many memoirs, chiefly devoted to the further exposition of his views with respect to the affinities of birds, but some of them descriptive of new or rare Mammalia, or new forms of exotic insects or birds.

Mr. Vigors was a man of very considerable attainments as a scholar as well as a naturalist, and made a liberal use of an ample private fortune in the promotion of those sciences which he cultivated: he was the representative in Parliament, for some years before his death, first of the city, and lastly of the county of Carlow.

Mr. Rickman was born in 1771, and educated at Westminster School, from whence he proceeded as a student to Christ Church, Oxford. Early in life he was recommended by Dean Jackson as

* Linnean Transactions, vol. xiv. † Ibid., vol. xv.

Secretary to Mr. Abbott, the Speaker of the House of Commons, and was chosen to examine and digest the Parliamentary returns under the first Population Act in 1800, a duty which he continued to perform at the three succeeding decennial periods, and was preparing to discharge it for the fifth time during the present year, when he was attacked by the disease which terminated in his death. He was appointed second Clerk Assistant to the House of Commons in 1815, and subsequently Clerk Assistant, an office which he continued to hold for the remainder of his life.

The introductions to the "Population Returns," of which he was the author, are remarkable for the very able analysis which they contain of the general condition, changes and prospects of all classes of the population.

Mr. Rickman was an excellent classical scholar, and was, in addition to many other attainments, extremely well acquainted with many branches of engineering and practical mechanics. He was the intimate friend, and after his death the executor, of the late Mr. Telford, whose autobiography he published, with a preface and an atlas of engravings descriptive of his principal works, which is in every way worthy of the fame of that great engineer.

Sir Jeffrey Wyattville, member of the Royal Academy and a distinguished architect, was a member of a family which has long been honourably connected with the arts. He was born in 1766, and acquired a knowledge of his profession under the instructions of his father and uncle, and was subsequently employed, during many years, in the somewhat ambiguous capacity of architect and builder in the execution of many considerable works. In 1824 he was selected by George IV., to whom he had been formerly known, to design and superintend the magnificent alterations and additions to Windsor Castle, a truly royal and national work, in which he succeeded in combining uncommon external grandeur and strict architectural propriety with great convenience and splendour of internal arrangements. Sir Jeffrey Wyattville, besides many important original works, made very extensive additions to the principal mansions of our nobility, including Chatsworth, Longleat, Woburn, Badminton, and Ashridge. He was a man of sound judgment and great integrity, and was very generally beloved for the remarkable simplicity and frankness of his manners, his great kindness of heart, and cheerful and unaffected good humour. He died in February last, and was buried in St. George's Chapel, at Windsor, in a vault which he had himself prepared for the reception of the remains of a beloved daughter, who died in the flower of her age.

Captain Charles Phillipps, of the Royal Navy, was the author of several inventions of great value in navigation, and in the equipment and management of ships: such are his methods of suspending compasses so as to avoid concussions in time of action; his improvement of the pump-dale of ships, and more particularly the capstan, which bears his name, and which is in general use in the Navy. He was an active and enterprising officer, who had seen much service during the last war, had been eminently successful in rescuing

slaves off the coast of Africa, and had nearly fallen a victim, in common with the greatest part of his crew, to that pestilential climate.

Sir ROBERT SEPPINGS received his education as a shipwright under the late Sir John Henslow, Surveyor of the Navy, and continued in connexion with the important service of our dock-yards during a period of fifty years. He was the author of many important improvements in our naval architecture, including his system of diagonal bracing and trussing, which formed the subject of two memorable Papers in our Transactions in the years 1814* and 1818 †, and which attracted an unusual amount of public attention. The great principle of this method was such an arrangement of the principal timbers as would oppose a powerful mechanical action to every change of position of the ribs and other timbers in every part of the ship; thus firmly compacting together the entire fabric, and preventing that perpetual racking of beams and working of joints, which, in the ancient system of ship-building, produced hogging, creaking, leakage, and rapid decay; and filling up likewise every vacuity between the timbers, which were occasionally the unavoidable receptacles for foul air, filth, vermin, and various other sources of rottenness and disease.

These important improvements, though opposed to the inveterate prejudices of the older shipwrights, a body of men who have not sufficiently valued and understood, in this country at least, the just principles of mechanical action, in the practical operation of ship-building, were universally adopted in the Navy under the enlightened administration of Mr. Charles York, and the powerful advocacy of Sir John Barrow ‡: and the merit of their author was acknowledged by his appointment as Surveyor of the Navy, and by the award of the Copley Medal of this Society.

This was not the only important improvement which Sir Robert Seppings introduced into our system of naval architecture. The Admiralty presented him with £1000 as a reward for his simple yet most useful invention of an improved block for supporting vessels, by which their keels and lower timbers were much more easily and promptly examined and repaired. His plan for lifting masts out of the steps, which superseded the employment of sheer hulks for that purpose, has been the means of saving much expense and labour. His new mode of framing ships has led to a much more extensive use of short and small timbers, which were formerly of little value; but the most valuable of all the reforms of construction for which the Navy of England is indebted to him, was the substitution of round for flat sterns, which afford increased strength to the frame-work of the ship, greater protection against *pooping* in heavy seas,

* On a New Principle of Constructing His Majesty's Ships of War.—Phil. Trans. 1814, p. 28.

† On the great strength given to Ships of War by the application of Diagonal Braces.—Phil. Trans. 1818, p. 1.

‡ In very able articles in the 24th and 43rd Numbers of the Quarterly Review.

an almost equal power of anchoring by the stern and by the bow, a more secure and effective position for the rudder, and a stout platform for a powerful battery, embracing a sweep of more than 180°. This capital improvement was strenuously opposed by many distinguished naval officers, who regretted the loss of those magnificent cabins, which were better suited for purposes of state than of service; but the good sense of less prejudiced judges happily prevailed, and secured for our ships of war an additional claim upon the respect of our enemies.

Foreign nations have not been tardy to acknowledge the value of these important improvements, and their author received many substantial proofs of their sense of his merits; and we may safely affirm, that in the national record of the great benefactors of their country, there are few names which will deserve, and, we trust, continue to receive, a more grateful commemoration than that of Sir Robert Seppings.

It has long been the practice of the Royal Society to associate with its body those persons in our country who are most eminent for their high rank or their commanding talents, for their distinguished public services, for their accomplishments in the arts, for their attainments in literature, for the important influence which their virtues or labours may have exercised upon the character and prospects of society, or upon the general interests of humanity; wisely judging that science will gain both in the enlargement of its objects and in the dignity and estimation of its cultivators, by being thus united with whatever is best entitled to command and to receive the admiration and respect of mankind: it is amongst this class of our Members that I have to notice several losses of more than ordinary importance.

The Earl of Mansfield was a nobleman of illustrious family, who, in addition to many other accomplishments, was one of the most elegant and effective parliamentary orators of his day.

Lord Holland was Chancellor of the Duchy of Lancaster, and a nobleman who was remarkable for his profound knowledge of the constitutional history of his country, and for the extent and variety of his literary attainments*. It was the remark of a well-known philosophical author and writer, "that there was something so sweet in the blood of the Foxes, that no one could approach them without feeling the fascination of their social powers:" and there was probably no man of his age who was the object of more enthusiastic love and admiration of his friends, private and political, than Lord Holland.

Sir William Sydney Smith was a hero in the most chivalrous period of our naval history, the scenes of whose early triumphs have so recently been rendered illustrious by others of an equally memorable character.

Sir John Lubbock was one of those persons engaged in trade whose extensive transactions and liberal views give dignity to the

* He was the author of a most elegant account of the life and writings of Lope de Vega, accompanied by some beautiful translations of his more remarkable poems.

operations of commerce: it is not one of the least distinctions of such a father, that his name and honours have been inherited by one whose profound acquirements in the most difficult branches of science have merited and received the highest honours which this Society is able to confer.

In our foreign list we have to lament the loss of three of our most illustrious members, Blumenbach, Olbers, and Poisson.

JOHN FRIEDRICH BLUMENBACH was born on the 11th of May, 1752, at Gotha, where his father was Prorector of the Gymnasium. He was accustomed to attribute the formation of his taste for literary history and the study of the natural sciences to the instructions and encouragement of Menz and Christ, two professors of Leipsig, who were friends and fellow-townsmen of his father. After studying for some time at Jena, he removed to Göttingen, for the purpose of completing his medical course, where he was very favourably noticed by Heyne and Michaelis, and more particularly by Büttner, Professor of Natural History, a great linguist, and a man of very extraordinary acquirements, whose museum of medals and natural history, when afterwards purchased by the University, he was employed to arrange. The skill and diligence which he showed in this employment, and the reputation of his professional and other attainments, secured him the appointment of Extraordinary Professor of Medicine in 1776, and of Ordinary Professor in 1778, a situation which he continued to hold for nearly sixty years.

His lectures comprehended Natural History, Comparative Anatomy, Physiology and Pathology, on all which subjects he published many valuable memoirs and other works, more particularly his admirable *Manuals*, which have long enjoyed an extraordinary popularity, and which have been translated into nearly every great European language.

The first of this series of publications was the "Handbuch der Naturgeschichte," which appeared in 1779. In his "Institutiones Physiologicæ," a work equally remarkable for the originality, precision and clearness of its statements, which was published in 1787, he made known his views on the "bildungs trieb," or "Nisus formativus," which he had before announced in the Göttingen Transactions for 1785, and which he made the subject of a special work in 1789*. His "Specimens of the Physiology of Warm- and Cold-blooded Animals," appeared in 1789. In 1794 he published in our Transactions, "Observations on some Egyptian Mummies opened in London in 1792," with especial reference to the three distinct varieties of national physiognomy which appear amongst them. His "Handbuch der vergleichenden Anatomie" appeared in 1805, and showed how fully he already appreciated the important views of Cuvier, which elevated Comparative Anatomy from a merely descriptive science to one which was capable of the most instructive generalizations, and affording the means of distinguishing types and laws of formation, as well for different organs as for different classes of animals.

* Ueber den Bildungs trieb.

The term *nisus formativus* was employed by Blumenbach to denote that *vital power* which is innate in all living organized bodies, and in active operation during the whole period of their vital existence, by which they are controlled and modified with reference to a specified end; it is that power by which the organizable matter of every individual being assumes, at its conception, its allotted form; which form is also capable of successive modifications by nutrition, according to the purpose for which it is destined by the Author of Nature, as well as of the reparation (within prescribed limits) of the injuries which it may have received. The announcement of this principle was received with extraordinary favour by physiologists, though it differed in little more than in name from the *vis essentialis* of the celebrated Wolff. It will be found to have formed the basis of some of his important speculations.

Blumenbach's well-known collection of the crania of the different races of mankind was made with a view to their more accurate classification, and gave rise to some of his more celebrated publications*. According to his ultimate views, he would make the Caucasian race the primary stem, from which all the others have degenerated to the Mongol at one extremity, and the Æthiopic at the other, interposing the American variety between the Caucasian and the Mongol, and the Malay between the Caucasian and the Æthiopic: it is difficult, however, to arrive at very correct general conclusions on this very interesting subject, without reference to those which are founded on the analogies of language, as has been done by Cuvier and Prichard.

It is quite impossible, within the short compass to which this notice is necessarily confined, to convey more than a very general impression of the vast variety of the labours of this distinguished philosopher. We find him applying his knowledge of natural history in illustration of the arts and poetry of antiquity†; he was also one of the first naturalists who appreciated the importance of a knowledge of fossils in determining the relative ages of the strata of the earth‡. He had cultivated archæology and literary history§ from his earliest years with more than common interest and zeal. There were, in fact, few departments of knowledge and literature, however remotely connected with the natural sciences, which he has not illustrated by his writings: it was when thus travelling

* Collectio Decad. vi. craniorum diversarum gentium tabulis 60 æneis illustrata: 1790—1820. De generis humani varietate nativâ: 1795.

† Specimen historiæ naturalis, antiquæ artis operibus illustratæ eaque vicissim illustrantis: 1803. Com. Acad. Gott., tom. xvi.

Specimen historiæ naturalis ex auctoribus classicis, præsertim poetis, illustratæ eosque vicissim illustrantis: 1815. Com. recent. Acad. Gott., tom. cxi.

‡ Beiträge zur Naturgeschichte der Vorwelt: 1790. Specimen archæologice telluris terrarumque imprimis Hannoveranarum: 1801. Also Comment. Acad. Gott., tom. xv. pp. 132—156. Com. recent. Acad. Gott., tom. cxi. pp. 3—24.

§ His "Introductio in Historiam Medicinæ Literariam," published in 1786, is a most instructive specimen of scientific bibliography.

into provinces of knowledge which were somewhat foreign to his own, that he was accustomed to quote the adage of Seneca: "*Soleo et in aliena castra transire, non tanquam transfuga, sed tanquam explorator.*"

Blumenbach had long been considered as the patriarch of the University of Göttingen, and was allowed the full privileges attached to his distinguished reputation, to the memory of his long services, and to the respect due to his venerable old age; he retained his usual cheerfulness, his memory, and much of his ancient activity, until nearly the close of his life. He died on the 22nd of January last, in the 88th year of his age, a memorable proof that the tranquil pursuits of science and the gentle stimulus of constant though not laborious employments are equally favourable to contentment of mind and length of days.

The name of the venerable Dr. Olbers, of Bremen, must be for ever memorable in the annals of astronomy, as the discoverer of two planets in our system. He was a member of that remarkable association of twenty-four astronomers which the indefatigable Baron de Zach of Gotha had formed towards the close of the last century, who undertook the vigilant observation of as many zones of the heavens, with a general view of discovering new comets and planets, and of recording any remarkable phenomena that might occur. Their zeal in the prosecution of these researches had been stimulated by the recent discovery of Herschel, as well as by the revival of a suggestion made by Kepler of the probable existence of a planet between Mars and Jupiter, in conformity with one of those mystical analogies, which might have been treated as the visionary dreams of an enthusiast, if they had not been so intimately connected with the discovery of the great laws forming the true basis of all correct knowledge of the system of the universe. The absence likewise of a planet at the distance from the sun, represented by 28, that of the earth being 10, interfered with the completeness of an empirical law which Bode of Berlin had suggested, and was not without its influence in confirming their faith in these extraordinary anticipations. The labours of this Association had been hardly organized, when the remarkable discovery of Ceres by Piazzi on the first day of the present century, in almost the precise position which Bode's singular law had assigned to it, seemed at once to convert their dreams into realities. Dr. Olbers calculated a circular, and Gauss an elliptic orbit for the same planet; and so wonderful was the accuracy of the first approximation to the elements which the latter had made, that they enabled Olbers to re-discover it on the 1st of January 1802, exactly one year after it had been first observed. It was in consequence of having formed a configuration of stars in the geocentric route of this planet, with a view to its being more readily found, that he discovered Pallas on the 25th of March of the same year*, at nearly the same distance from the sun†,

* "Ueber einen neuen von Dr. Olbers in Bremen endeckten höchst sonderbaren cometen." Zach's Monatliche Correspondenz for May, 1802.

† If the distance of the earth from the sun be 1, that of Ceres is 2·7674,

though moving in an orbit more than three times as much inclined to the plane of the ecliptic. The discovery of two planets, in the position where one of them had been so anxiously sought for *, induced Dr. Olbers to conjecture that they were fragments of a larger planet, which had been scattered by some great catastrophe, and that many others probably existed at nearly the same distance from the sun, and possessing common nodes: he therefore earnestly recommended astronomers to observe most carefully those spaces of the heavens in which the nodes of these planets are placed; a practice which he himself observed for many years. His exemplary diligence was rewarded by the discovery of Vesta on the 29th of March, 1807, nearly in the precise position in which he had conjectured that it was most likely to be found †. This was the last of those remarkable discoveries whose history illustrates in so striking a manner that union of profound, yet somewhat visionary speculation, with unconquerable perseverance, which is so characteristic of the German nation.

His well-known method of calculating the orbits of comets, which has been so generally used by German astronomers, was published at Weimar in 1797‡, with a commendatory preface by his zealous friend the Baron de Zach. This memoir, independently of its other merits, is sufficient to show that its author was a mathematician of very considerable powers, and perfectly acquainted with the works of contemporary astronomers.

Dr. Olbers was a diligent observer of comets; and there are few astronomers who have contributed so much to our knowledge of these singular bodies. He was the discoverer of several comets, including the celebrated comet of long period of 1815; and we are indebted to him, not merely for very important suggestions and observations respecting the celebrated comet of Encke, but still more for having developed the taste for astronomical calculations and observations of that great astronomer, who for many years served him in the capacity of assistant in his observatory.

The Baron de Zach visited this observatory in September, 1800 §, and has described the simple apparatus which enabled him to make so many important discoveries. It was placed in the upper part of his house in the midst of the town of Bremen, and afforded openings or platforms sufficient to afford a command of nearly every point of the heavens. His instruments were an excellent five-foot Dollond of $3\frac{3}{4}$ inches aperture, with a circular micrometer (which he used in the observation of the small planets), a five-foot reflecting telescope

and that of Pallas 2·7676: the difference is less therefore than 19,000 miles.

* Their essays on this subject were generally headed, "On the long-expected Planet between Jupiter and Mars."

† The longitude of the ascending node of Pallas is 172° 32′ 35″; that of Vesta is 171° 6′ 37″.

‡ Abhandlung ueber die lechteste und bequemste methode die Bahn eines cometen aus einigen beobachtungen zu berechnen.

§ Monatliche Correspondenz for Feb. 1801.

by Schröter, a quadrant by Bird, an admirable sextant by Troughton, and a clock by Castens of Bremen. He possessed no transit instrument or fixed instruments of any kind; yet he speedily availed himself of the circumstances of his locality to determine his time with great accuracy, as well as nearly every element which the peculiar character of his observations rendered necessary; so fertile are the resources of genius and enterprize to overcome difficulties, which by ordinary men would be abandoned as altogether insuperable.

SIMEON DENIS POISSON, one of the most illustrious men of science that Europe has produced, was born at Pithiviers on the 21st of June, 1781, of very humble parentage, and was placed, at the age of fourteen, under the care of his uncle, M. L'Enfant, surgeon, at Fontainebleau, with a view to the study of his profession. It was at the central school of this place that he was introduced to the notice of M. Billy, a mathematician of some eminence, who speedily discovered and fostered his extraordinary capacity for mathematical studies. In 1793 he was elected a pupil of the École Polytechnique, which was then at the summit of its reputation, counting amongst its professors Laplace, Lagrange, Fourier, Monge, Prony, Berthollet, Fourcroy, Vauquelin, Guyton Morveau, and Chaptal. The progress which he made at this celebrated school surpassed the most sanguine expectations of his kind patron, M. Billy, and secured him the steady friendship and support of the most distinguished of his teachers.

In the year 1800, he presented to the Institute a memoir "Sur le nombre d'intégrales complètes dont les équations aux différences finies sont susceptibles," which cleared up a very difficult and obscure point of analysis. It was printed on the recommendation of Laplace and Lagrange in the *Mémoires des Savans Etrangers*, an unexampled honour to be conferred on so young a man.

Stimulated by this first success, we find him presenting a succession of memoirs to the Institute on the most important points of analysis, and rapidly assuming the rank of one of the first geometers of his age. He was successively made Répétiteur and then Professor of the Polytechnic School, Professor at the Collège de France and the Faculté des Sciences, Member of the Bureau des Longitudes, and finally, in 1812, Member of the Institute.

His celebrated memoir on the *invariability* of the major axes of the planetary orbits, which received the emphatic approbation of Laplace, and secured him throughout his life the zealous patronage of that great philosopher, was presented to the Institute in the year 1808. Laplace had shown that the periodicity of the changes of the other elements, such as the eccentricity and inclination, depends on the periodicity of the changes of the major axis; a condition, therefore, which constitutes the true basis of the proof of the stability and permanence of the system of the universe. Lagrange had considered this great problem in the Berlin Memoirs for 1776, and had shown that, by neglecting certain quantities which might possibly modify the result, the expression for the major axis involved periodical inequalities only, and that they were consequently incapable of indefinite increase or dimi-

nution. It was reserved to Poisson to demonstrate *à priori* that the non-periodic terms of the order which he considered would mutually destroy each other; a most important conclusion, which removed the principal objection that existed to the validity of the demonstration of Lagrange*.

This brilliant success of Poisson in one of the most difficult problems of physical astronomy, would appear to have influenced him in devoting himself thenceforward almost exclusively to the application of mathematics to physical science; and the vast number of memoirs and works (amounting to more than 300 in number) which he published during the last thirty years of his life, made this department of mathematical science, and more particularly whatever related to the action of molecular forces, pre-eminently his own. They comprehend the theory of waves and of the vibrations of elastic substances, the laws of the distribution of electricity and magnetism, the propagation of heat, the theory of capillary attraction, the attraction of spheroids, the local magnetic attraction of ships, important problems on chances, and a multitude of other subjects, which the time allowed for this notice will not permit me to mention. His well-known treatise on Mechanics is incomparably superior to every similar publication in the clear and decided exposition of principles and methods, and in the happy and luminous combination of the most general theories with their particular and most instructive applications.

Poisson was not a philosopher who courted the credit of propounding original views which did not arise naturally out of the immediate subjects of his researches; and he was more disposed to extend and perfect the application of known methods of analysis to important physical problems, than to indulge in speculations on the invention or transformation of formulæ, which, however new and elegant, appeared to give him no obvious increase of mathematical power in the prosecution of his inquiries. His delight was to grapple with difficulties which had embarrassed the greatest of his predecessors, and to bring to bear upon them those vast resources of analysis, and those clear views of mechanical and physical principles in their most refined and difficult applications, which have secured him the most brilliant triumphs in nearly every department of physical science.

The confidence which he was accustomed to feel in the results of his analysis—the natural result of his own clear perception of the necessary dependence of the several steps by which they were deduced—led him sometimes to accept conclusions of a somewhat

* The publication of this memoir recalled the attention of this illustrious mathematician to a subject which he had long neglected, and gave rise to three of his noblest memoirs. Poisson, in his "Mémoire sur le Mouvement de la Lune autour de la Terre," has not satisfactorily shown that the major axis of the moon's orbit contains no argument of long period amongst the terms which involve lower powers of a certain quantity *m*, which denotes the ratio of the sun's mean motion to that of the moon, than the fourth; a demonstration of this most important proposition has been given by Sir John Lubbock in the Philosophical Magazine for the present year.

startling character: such were his views of the constitution and finite extent of the earth's atmosphere, which some distinguished philosophers have ventured to defend. It is not in mathematical reasonings only that we are sometimes disposed to forget that the conclusions which we make general are not dependent upon our assumed premises alone, but are modified by concurrent or collateral causes, which neither our analysis nor our reasonings are competent to comprehend.

The habits of life of this great mathematician were of the most simple and laborious kind; though he never missed a meeting of the Institute, or a lecture, or an examination, or any other public engagement, yet on all other occasions, at least in his later years, he denied access to all visitors, and remained in his study from an early hour in the morning until six o'clock at night, when he joined his family at dinner, and spent the evening in social converse, or in amusements of the lightest and least absorbing character, carefully avoiding every topic which might recall the severity of his morning occupations. The wear and tear, however, of a life devoted to such constant study, and the total neglect of exercise and healthy recreations, finally undermined his naturally vigorous constitution, and in the autumn of 1838 the alarming discovery was made that he was labouring under the fatal disease of water in the chest. The efforts of his physicians contributed for a time to mitigate the more serious symptoms of his malady; but every relaxation of his sufferings led to the resumption of his labours; and to the earnest remonstrances of his friends, and the entreaties of his family, he was accustomed to reply, that to him *la vie c'était le travail*; nay, he even undertook to conduct the usual examinations of the École Polytechnique, which occupied him for nearly ten hours a day for the greatest part of a month. This last imprudent effort ended in an attack of paralysis, attended by loss of memory and the rapid obscuration of all his faculties; he continued to struggle, amidst alternations of hope and despondency, for a considerable period, and died on the 25th of April last, in the fifty-ninth year of his age.

Poisson was eminently a deductive philosopher, and one of the most illustrious of his class; his profound knowledge of the labours of his predecessors, his perfect command of analysis, and his extraordinary sagacity and tact in applying it, his clearness and precision in the enunciation of his problems, and the general elegance of form which pervaded his investigations, must long continue to give to his works that classical character, which has hitherto been almost exclusively appropriated to the productions of Lagrange, Laplace, and Euler. If he was inferior to Fourier or to Fresnel in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power: if some of his contemporaries rivalled or surpassed him in particular departments of his own favourite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labours.

The last work on which he was engaged was a treatise on the theory of light, with particular reference to the recent researches of

Cauchy: nearly two hundred pages of this work are printed, which are altogether confined to generalities, whose applications were destined to form the subject of a second and concluding section: those who are acquainted with the other works of Poisson will be best able to appreciate the irreparable loss which optical science has sustained in the non-completion of such a work from the hands of such a master.

The Statutes relating to elections were then read by the Secretary.

Joseph Smith, Esq. and Archibald John Stephens, Esq., were appointed Scrutators to assist the Secretaries in examining the balloting lists.

The ballot was then taken, and Dr. Roget, on the part of the Scrutators, reported the following gentlemen as being duly elected Officers and Council for the ensuing year:

President.—The Marquis of Northampton.

Treasurer.—Sir John William Lubbock, Bart., M.A.

Secretaries.—Peter Mark Roget, M.D.;
Samuel Hunter Christie, Esq., M.A.

Foreign Secretary.—John Frederic Daniell, Esq.

Other Members of the Council.—George Biddell Airy, Esq., M.A., A.R.; Sir John Barrow, Bart.; Thomas Bell, Esq.; William Thomas Brande, Esq.; Richard Bright, M.D.; Sir Benjamin Brodie, Bart.; The Earl of Burlington; Bryan Donkin, Esq.; William Henry Fitton, M.D.; Edward Forster, Esq.; The Very Rev. the Dean of Ely, D.D.; Richard Phillips, Esq.; The Rev. Baden Powell; Major Edward Sabine, R.A.; Lieut.-Col. William H. Sykes; Rev. Robert Willis, M.A.

The Thanks of the Meeting were given to the Scrutators for their trouble in examining the lists.

The following is the statement with respect to the Receipts and Payments of the Society during the preceding year, which was laid on the table by the Treasurer:—

Statement of the Receipts and Payments of the Royal Society between Nov. 28, 1839, and Nov. 28, 1840.

RECEIPTS:—				£	s.	d.
Balance in the hands of the Treasurer at the last Audit ..				1808	9	7
27 Weekly Contributions, at one shilling	70	4	0			
184 Quarterly Contributions	697	0	0			
				767	4	0
Carried forward..				2575	13	7

	£	s.	d.	£	s.	d.
Brought forward ..				2575	13	7
31 Admission Fees				310	0	0
4 Compositions for Annual Payments at £60..........				240	0	0
Rents :—						
One year's rent of estate at Mablethorpe: due at Michaelmas 1840	107	0	0			
One year's rent of lands at Acton: due at Michaelmas, 1840	60	0	0			
One year's fee-farm rent of lands in Sussex; land-tax deducted: due at Michaelmas, 1840	19	4	0			
One-fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's will: due at Midsummer, 1840	3	0	0			
				189	4	0
Dividends on Stock :—						
One year's dividend on £14,000 Reduced 3 per cent. Annuities	420	0	0			
Dividend on £3452. 1. 1 Consols, the produce of the sale of the premises in Coleman-street..........................	103	11	2			
One year's dividend on £200 Consols	6	0	0			
Donation Fund.						
Half year's dividend on £4150. 0. 0 Consols	62	5	0			
Half year's ditto .... £4544. 16. 9 Consols	68	3	5			
Rumford Fund.						
One year's dividend on £2292. 11. 7 Consols	68	15	6			
Fairchild Fund.						
One year's dividend on £100 New South Sea Annuities	3	0	0			
				731	15	1
Miscellaneous Receipts :—						
Sale of Philosophical Transactions, Abstracts of Papers, and Catalogue of the Royal Society's Library				251	2	6
Sale of Catalogue to Subscribers, as also Old Catalogue and Sir Humphry Davy's Discourses				36	16	6
For Books purchased for Antarctic Expedition..........				4	0	0
Received from the Treasury on Account of Disbursements for the Antarctic Expedition and fixed Observatories	1182 106	9 4	2 0			
				1288	13	2
Basire (contra) paid in last year's account............				98	4	0
Total Receipts				£5725	8	10

Payments :—	£	s.	d.	£	s.	d.
Fairchild Lecture.—The Rev. J. J. Ellis, for delivering the Fairchild Lecture for 1840				3	0	0
Bakerian Lecture.—George Biddell Airy, Esq., for the Bakerian Lecture for 1840				4	0	0
Rumford Fund.—						
Mr. Wyon, for Gold and Silver Rumford Medal				64	0	0
Donation Fund.—						
Cost of £394. 16. 7, 3½ Consols				358	6	4
British Museum Fund.—	£	s.	d.			
Bailliere: for Books	63	15	0			
Maynard: for ditto	20	5	6			
Simpkin and Co.: for ditto	8	0	6			
Willis: for ditto	3	7	0			
Sotheby: for ditto	15	13	6			
				111	1	6
Salaries :—						
Dr. Roget, one year, as Secretary	105	0	0			
S. H. Christie, Esq., one year, as Secretary	105	0	0			
Ditto for Index to Phil. Trans.	5	5	0			
John F. Daniell, Esq., one year, as For. Sec.	20	0	0			
Mr. Roberton, one year, as Assistant-Secretary	200	0	0			
Mr. W. E. Shuckard, one year, as Librarian	50	0	0			
Mr. Holtzer, one year, as Porter	30	0	0			
Ditto, for extra Porterage	10	0	0			
				525	5	0
Mablethorpe Tithe Suit:—Society's proportion of the Costs of defending the Suit				83	9	10
Fire Insurance, on the Society's Property				22	11	6
Mrs. Coppard: Gratuity				10	0	0
Mr. Shuckard, for making Catalogue of MSS. Letters				42	0	0
Mr. Panizzi: for Royal Society's Catalogue				328	0	0
Bills :—						
Taylor:						
Printing the Phil. Trans., 1839, part 2	141	16	0			
Ditto, 1840, part 1; Proceedings, Nos. 40—44; Circulars, Lists of Fellows, Ballot-lists, Statement of Payments, and Minutes of Council; &c. &c.	292	6	0			
Bowles and Gardiner:						
For Paper for the Phil. Trans., 1839, part 2, and 1840, part 1	150	0	0			
Basire:						
For Engraving and Copper-plate Printing for Phil. Trans., 1839, part 2	97	1	9			
Ditto, 1840, parts 1 and 2, &c.	300	11	3			
Gyde:						
Boarding and Sewing 800 Parts of Phil. Trans., 1839, part 2	27	4	0			
Ditto, 1840, part 1	27	4	0			
				1036	3	0
Carried forward				2587	17	2

	£	s.	d.	£	s.	d.
Brought forward..				2587	17	2
Taylor:						
Printing the Report of the Physical Committee	135	5	2			
Gardner:						
Map of Magnetic Intensity, for Report of Physical Committee	27	16	0			
Cox and Sons:						
Form Books, &c. for Magnetic Observatories to ditto	13	17	0			
Pouncey and Sons:						
For Stationery	14	19	0			
Saunderson:						
For Shipping Expenses	3	3	3			
Brecknell and Turner:						
Wax Lights, Candles, and Lamp Oil	37	5	6			
Cubitt:						
For Book-Cases, Stoves in Library, and Repairing Windows, Carpets, &c.	168	17	2			
Exchequer Fee for paying dividend	0	13	0			
Clerks: Christmas Fee	1	1	0			
Arnold:						
For Coals	18	17	0			
Ditto (Porter's yearly allowance)	4	7	0			
Murray:						
For taking Meteorological Observations	7	0	0			
Tuckett:						
Bookbinding	261	17	6			
Feetham:						
For Alterations of Stoves in the Council Room and Library	16	16	0			
Gwillim:						
Mats, Brushes, Fire-wood, &c.	6	14	5			
Few, Hamilton and Few, Solicitors:						
Law Expenses	55	5	3			
Packer:						
Ingrossing Addresses to Her Majesty and Prince Albert	7	3	0			
				780	17	3
Taxes and Parish Rates:						
Land and Assessed Taxes	30	17	0			
Poor Rate	17	0	0			
Church Rate	4	5	0			
Rector's Rate	3	3	9			
				55	5	9
Petty Charges:						
Hodson: Silliman's Journal, Nos. 76—80	1	17	6			
Repairing Chandelier in Meeting Room	3	10	0			
Carried forward..	5	7	6	3424	0	2

	£	s.	d.	£	s.	d.
Brought forward..	5	7	6	3424	0	2
Hartnup: for extending Barometrical Tables	2	0	0			
Frame for Oldenburgh	2	0	0			
Charwoman's Wages..................	27	6	0			
Ditto, Extra work	4	10	6			
Stamps	2	19	6			
Postage and Carriage..................	7	5	1			
Expenses on Foreign Packets, &c.........	6	9	4			
Library and Window-cleaning, &c.	2	8	6			
Miscellaneous expenses	14	9	6			
				74	15	11

An Account of Disbursements for the Antarctic Expedition and Magnetic Observatories.

	£	s.	d.	£	s.	d.	£	s.	d.
On Account of the Observatories:—									
Newman	280	11	6						
Deane	240	8	0						
Huxley	39	10	11						
Allen and Co.	99	18	0						
Troughton and Simms	33	10	6						
Jones and Causton........	27	17	0						
Osler	6	6	0						
Wilmot	4	15	9						
Lefroy	3	19	6						
Sabine	10	16	0						
				747	13	2			
Expedition and Observatories conjointly:—									
Taylor	95	5	6						
Basire	98	4	0						
Adie	75	11	6						
Arnold and Dent	54	10	0						
				323	11	0			
Antarctic Expedition:—									
Newman	188	16	0						
Robinson	19	15	0						
Watkins and Hill	6	18	0						
Troughton and Simms	1	10	0						
Packer	0	10	0						
				217	9	0	1288	13	2

	£	s.	d.
Total Payments	£4787	9	3
Total Receipts and Balance	5725	8	10
Balance in the hands of the Treasurer	£ 937	19	7

JOHN WILLIAM LUBBOCK, *Treasurer*.

November 28th, 1840.

The Balances in hand, now belonging to the several trusts, are as under: viz :—

	£	s.	d.
British Museum Fund	54	10	4
Donation Fund	130	8	5
Rumford Fund	71	11	6

The following table shows the progress and present state of the Society, with respect to the number of Fellows :—

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2. 12s. Annually.	Paying £4 Annually.	Total.
November, 1839 ..	11	48	556	27	166	808
Since elected......	1	4	3	......	29	37
Since re-instated ..	......	......	......	......	+1	1
Since compounded	......	......	+1	......	−1	
Since deceased, &c.	......	−3	−23	−2	−5	−33
Withdrawal	......	......	......	......	−1	−1
November, 1840	12	49	537	25	189	812

Weekly and Quarterly Contributions.

1830......................	£363	4	0
1831......................	286	0	0
1832......................	255	6	0
1833......................	283	7	6
1834......................	318	18	6
1835......................	346	12	6
1836......................	495	0	0
1837......................	531	0	0
1838......................	599	4	0
1839......................	666	16	0
1840......................	763	4	0

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1840—1841. No. 46.

December 10, 1840.

SIR JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

A Memorandum, addressed to the Royal Society, November 28th, 1840, by Martin Barry, M.D., F.R.S., L. & Ed., was read.

Dr. Barry, in reference to the memorandum of Mr. Wharton Jones, claiming for himself the contemporaneous discovery of the germinal spot in the mammiferous ovum, states that, after having bestowed considerable pains to ascertain who was the original observer of a structure which has proved to be of great importance, he had mentioned incidentally in his paper the result of his inquiry, namely, that the merit of the discovery was due to Professor Rudolph Wagner; but observes that the inquiry may be resumed by all who will take the trouble to examine the works, both in German and English, on this subject; and that he will ever be open to conviction, and ready to declare his change of opinion, on the production of sufficient evidence.

A communication was also read, entitled "Supplementary Note to a Paper, entitled 'Researches in Embryology. Third Series: a Contribution to the Physiology of Cells.'" By Martin Barry, M.D., F.R.S., L. & Ed.

In the paper referred to, the author had shown, that after the ovum of the Rabbit has entered the Fallopian tube, cells are found collected around its thick transparent membrane or "zona pellucida"; which cells, by coalescing, form a thinner membrane—the incipient chorion. He now adds, that the formation of this thinner membrane does not exhaust the whole layer of these cells; but that a stratum of them is found remaining on, and entirely surrounding the "zona", after the thinner membrane has risen from it. The fluid space also, between the "zona" and the thinner membrane, presents a large number of cells or discoid objects, each of which contains a brilliantly pellucid and highly refracting globule. In some parts, several of these discs, closely joined together, have the appearance of shreds of membrane; in others, there are found pellucid globules, some of which are exceedingly minute. The discs now mentioned collect at the periphery, for the thickening of the chorion. They seem to

proceed from the region of the "zona"; and probably have their origin in the cells by which the latter is surrounded. If so, the author thinks we cannot suppose them to arise in any other way than that which, according to his observations, appears to be the universal mode of reproduction; namely, by division of the nuclei of the parent cells. Nor can we suppose that minuteness is any hinderance to their subsequent increase by the same means.

December 17, 1840.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following communications were made to the Society, viz.

1. "Present state of the Diamond Mines of Golconda." By T. J. Newbold, Esq., of the Madras Army, A.D.C. to Major-General Wilson, K.B. Communicated by S. H. Christie, Esq., M.A., Sec. R.S.

The author gives an account of the tract of country in which the diamond mines of Golconda are situated, and of the processes by which the diamonds are obtained. The latter consist merely in digging out the rolled pebbles and gravel, and carrying them to small square reservoirs, raised on mounds, having their bottom paved with stones, and then carefully washing them. Dry weather is selected to carry on these operations, in order to avoid the inconvenience and expense of draining. A description is then given of the mines of Banaganpully, Munimudgoo, Condapilly, Sumbhulpoor, and Poonah in Bundlekund.

2. "Magnetic-term Observations made at Milan." By Professor Carlini, Director of the Observatory at that place: also "Magnetic-term Observations made at Prague." By Professor Kreil, Director of the Observatory at that place.

3. "On the Production of Heat by Voltaic Electricity." By J. P. Joule, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The inquiries of the author are directed to the investigation of the cause of the different degrees of facility with which various kinds of metal, of different sizes, are heated by the passage of voltaic electricity. The apparatus he employed for this purpose consisted of a coil of the wire, which was to be subjected to trial, placed in a jar of water, of which the change of temperature was measured by a very sensible thermometer immersed in it: and a galvanometer, to indicate the quantity of electricity sent through the wire, which was estimated by the quantity of water decomposed by that electricity. The conclusion he draws from the results of his experiments is, that the calorific effects of equal quantities of transmitted electricity are pro-

portional to the resistances opposed to its passage, whatever may be the length, thickness, shape, or kind of metal which closes the circuit: and also that, *cæteris paribus*, these effects are in the duplicate ratio of the quantities of transmitted electricity; and consequently also in the duplicate ratio of the velocity of transmission. He also infers from his researches that the heat produced by the combustion of zinc in oxygen is likewise the consequence of resistance to electric conduction.

The President informed the Meeting that the Council had voted the following Address to Her Majesty, the Queen:—

"*To the Queen's Most Excellent Majesty.*

"The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, approach Your Majesty with the most heartfelt satisfaction at the birth of the Princess Royal. We feel the deepest gratitude to the Almighty Disposer of events for His gracious protection vouchsafed to Your Majesty in your late confinement, and we ardently pray that the same protection may continue to be long afforded to a life so precious to all the inhabitants of these realms.

"It is also our most ardent hope that Your Majesty's daughter may grow up to be a pattern of every virtue that can adorn and dignify her high station, and that Your Majesty may continue to be blest with every happiness, both public and private."

The President also stated to the Meeting, that the Council had adopted the following Address to His Royal Highness Prince Albert, of Saxe Coburg and Gotha:—

"*To His Royal Highness Prince Albert of Saxe-Coburg and Gotha, K.G., F.R.S.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to tender to Your Royal Highness our warmest congratulations on the safety and recovery of Your Royal Highness's Consort, our beloved Sovereign, and on the birth of Your Royal Highness's daughter. That she

may be the bond of your connubial happiness is our most sincere wish, and also that Divine Providence may long, very long, preserve Your Royal Highness's life, in possession of every blessing, both as a husband and as a father."

The Society then adjourned over the Christmas recess, to meet again on the 7th of January next.

January 7, 1841.

Sir JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

Julius Jeffreys, Esq., was balloted for and duly elected into the Society.

The following communication was read, viz.—

"Variation of the Magnetic Declination, Horizontal Intensity, and Inclination observed at Milan on the 23rd and 24th December 1840." Communicated by Professor Carlini, Director of the Milan Observatory.

A paper was also read, entitled, "On the Chorda dorsalis." By Martin Barry, M.D., F.R.S.S. L. & E.

The author of this communication, after pointing out the similarity in appearance between an object noticed by him in the mammiferous ovum, and the incipient chorda dorsalis described by preceding observers in the ova of other Vertebrata, mentions some essential differences between his own observations and those of others as to the nature and mode of origin of these objects, and their relation to surrounding parts. Von Baer, the discoverer of the chorda dorsalis, describes this structure as "the axis around which the first parts of the fœtus form." Reichert supposes it to be that embryonic structure which serves as "a support and stay" for parts developed in two halves. The author's observations induce him to believe that, instead of being "the axis *around which* the first parts of the fœtus form," the incipient chorda is the last-formed row of cells, which have pushed previously-formed cells farther out, and that, instead of being merely "a support and stay" for parts developed in two halves, the incipient chorda occupies the centre out of which the "two halves" originally proceeded as a single structure, and is itself in the course of being enlarged by the continued origin of fresh substance in its most internal part.

The author enters into a minute comparison of the objects in question; from which it appears that the incipient chorda is not, as Baer supposed, developed into a globular form at the fore end, but that the linear part is a process from the globular; and that the pellucid cavity contained within the latter—a part of prime importance, being the main centre for the origin of new substance—is not mentioned

by Von Baer. Farther, that the origin of the "laminæ dorsales" of this naturalist (the "central nervous system" of Reichert) is not simultaneous with, but anterior to, that of the chorda.

The author then reviews the observations of Rathke and Reichert on the chorda dorsalis, which contain internal evidence, he thinks, of a process in the development of Fishes, Reptiles, and Birds, the same as that which he has observed in Mammalia; namely, the origin of the embryo out of the nucleus of a cell.

And it is his opinion that this observation may assist to solve a question on which physiologists are not agreed; for it shows, that if the nucleus of a cell is a single object, the first rudiments of the embryo are not two halves. The author thinks that unless the very earliest periods are investigated, it is in vain that we attempt to learn what that is, of which the rudiments of the embryo are composed. From not attending to this, physiologists have supposed their "primitive trace" to arise in the substance of a membrane, which the author, in his second series on the embryo, showed could not be the case. To the same cause he thinks is referable an opinion recently advanced by Reichert, that the first traces of the new being are derived from cells of the yelk.

January 14, 1841.

Sir JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

Charles Enderby, Esq. and James Cosmo Melvill, Esq. were balloted for and duly elected into the Society.

A paper was read, entitled, "On the Corpuscles of the Blood." Part II. By Martin Barry, M.D., F.R.S.S. L. and E.

The observations recorded in this memoir are founded on an examination of the blood in every class of vertebrated animals, in some of the Invertebrata, and in the embryo of Mammalia and Birds. The nucleus of the blood-corpuscle, usually considered as a single object, is here represented as composed, in some instances, of two, three, or even many parts; these parts having a constant and determinate form. In the substance surrounding the nucleus, the author has frequently been able to discern, not merely "red colouring matter," but cell-like objects; and he points out an orifice as existing at certain periods in the delicate membrane by which this substance is surrounded. In a former memoir he had differed no less from previous observers regarding "cells." He had shown, for instance, that the nucleus of the cell, instead of being "cast off as useless, and absorbed," is a centre for the origin, not only of the transitory contents of its own cell, but also of the two or three principal and last-formed cells, destined to succeed that cell; and that a separation of the nucleus into two or three parts, is not, as Dr. Henle had supposed in the case of the Pus and Mucus-globule (the only instances

in which the separation in question had been observed), the effect of acetic acid, used in the examination,—but that such separation is natural, apparently common to nuclei in general, and forming part of the process by which cells are reproduced. The author had farther shown the so-called nucleolus to be not a distinct object existing before the nucleus, but merely one of a series of appearances arising in succession, the one within the other, at a certain part of the nucleus, and continuing to arise even after the formation of the cell. These views he now confirms; and in the present paper shows that they admit of being extended to the corpuscles of the blood.

He then compares appearances observed in the latter with those he had traced in the ovum. These relate to the number of parts of which the nucleus is at different periods composed,—the nature of the nucleolus,—the communication between the nucleolus and the exterior of the cell,—the formation of the contents of the cell out of the nucleus,—the final division of the nucleus into the foundations of a limited number of young cells, destined to succeed the parent cell,—and the escape of the young cells for this purpose. It follows from these investigations, that the corpuscles of the blood are generated by a process essentially the same as that giving origin to those cells which are the immediate successors of the germinal vesicle, or original parent cell; it being also by a continuation of the same process that the corpuscle of the blood divides itself into the minuter objects figured by the author in his former paper on the blood.

He adds, that in its form and internal state, the blood-corpuscle found in the adult of certain animals, very much resembles that existing only in the fœtal life of others. It is incidentally remarked, that the fœtal brain, at certain periods, appears to consist almost entirely of objects very much resembling those which, in some stages, form the nuclei in the fœtal corpuscles of the blood.

The author concludes, by expressing his opinion, that the mode of evolution of the minute mammiferous ovum is deserving of close attention, in connexion with some of the processes by which nourishment is communicated, and the growth of the body effected, at all future periods of life.

January 21, 1841.

Sir JOHN BARROW, Bart., V.P., in the Chair.

Peyton Blackiston, M.A. & M.D., Captain Henry Rowland Brandreth, R.E., and Joseph Edye, Esq., were balloted for and duly elected into the Society.

A paper was in part read, entitled, "On the action of certain Inorganic Compounds, when introduced directly into the Blood." By J. Blake, Esq., M.R.C.S. Communicated by P. M. Roget, M.D., Sec. R.S.

January 28, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The reading of a paper entitled, "On the action of certain Inorganic Compounds when introduced directly into the Blood." By James Blake, Esq., M.R.C.S. Communicated by P. M. Roget, M.D., Sec. R.S., was resumed and concluded.

The present paper is a continuation of a memoir read at the Académie des Sciences of Paris, in 1839, and entitled, "Effets de diverses substances salines, injectées dans le systême circulatoire *.

After some preliminary remarks on the mode in which the experiments were conducted, and on the assistance derived from the *hæmadynamometer* of Poiseuille (or instrument for measuring the pressure of the blood circulating in the vessels), the author gives a list of the various saline substances of which he noted the effects when they were severally injected either into the venous or the arterial systems, arranged according to the nature of those effects. He finds, in general, that all the salts having the same base exert similar actions when introduced directly into the blood. He carefully inquires into the phænomena apparently arising from the direct contact of each of the substances above enumerated with the animal tissues; and more particularly into the effects produced on the heart, on the muscular and the nervous tissues, and on the pulmonary and systemic capillaries.

The first series of experiments related are those on the action of the salts of magnesia: these are found, when introduced in any quantities into the blood, to arrest altogether the action of the heart; but a still more remarkable effect which results, is the complete prostration of muscular power. The salts of zinc have a similar operation under the same circumstances, but produce the same effects in smaller quantities. The action of the salts of copper, of lime, of strontia, of baryta, and of lead, are considered successively in the order in which they are more closely related by their physiological actions. The author particularly notices the peculiar action which the salts of the three last-named substances exercise on the muscular tissues, occasioning contractions in them during many minutes after death produced by their introduction into the blood. These muscular movements were, in some cases, observed forty-five minutes after the cessation of the heart's action. Experiments with the salts of silver and of soda are then detailed; substances, which exhibit a remarkable similarity in their actions on the pulmonary tissue, on the heart, and on the systemic capillaries: for while, in the case of all the other salts already mentioned, death seems to be produced by the destruction of the irritability of the heart, the fatal result with the salts of silver and of soda is the consequence of their action on the tissue of the lungs. The physiological actions of the salts of

* Published in the "Archives Générales de Médecine; Nov. 1839."

ammonia and of potass were found by the author not to correspond with any of the preceding. Although agreeing perfectly with one another in their action upon the heart and systemic capillaries, they differ extremely in their effects on the nervous tissue; ammonia being particularly distinguished from all inorganic compounds in this respect, and being very analogous to poisons derived from organic products, which it also resembles in its chemical properties.

The general conclusion which the author is led to draw from these researches is, that there exists a close relation between the chemical properties of the substances experimented upon, and their physiological effects; his experiments tending to prove, that, when introduced into the blood, substances which are isomorphous exert similar actions on the living tissues. He notices, however, two exceptions to this law; namely, the similarity of the actions exerted on the pulmonary tissue by the salts of lead with those of silver, although these salts are not isomorphous; and also the action on the nervous tissue of the salts of ammonia being different from that of the salts of potass. But he remarks that the oxide of lead bears a close analogy to the oxide of silver in its relation to organic compounds. The general fact previously announced by the author in his memoir read to the Academy of Sciences at Paris, namely, that salts with the same base have analogous actions, may be considered as a corollary of the above law.

February 4, 1841.

Sir JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

David Francis Atcherley, Esq., was balloted for and duly elected into the Society.

A paper was read, entitled, "On some Electro-Nitrogurets." By Wm. Robert Grove, Esq., M.A., F.R.S.

The author states that he has made many attempts to render permanent the ammoniacal amalgam, and that he has succeeded in freezing it by means of solid carbonic acid, during which solidification, and also while in its solid state, it underwent no chemical change. He subsequently attempted to procure a permanent compound by electrolyzing a solution of hydrochlorate of ammonia with an extremely fusible alloy at the cathode; but this attempt was unsuccessful. It then occurred to him, that by using an oxidable metal at the anode, which could be revived in conjunction with nascent hydrogen and nitrogen at the cathode, one or both of these elements might be combined with the solid metal, and so form permanent compounds.

The experiment made in this manner with the metals zinc, cadmium, and copper, was perfectly successful. A spongy mass col-

lected at the cathode, which floated upon the liquid, and which, when washed and dried, was analysed by heating in a tube retort; five grains of the zinc compound gave 0·73 of a cubic inch of permanent gas, which on examination proved to be nitrogen with one-fourth hydrogen. The same quantity of the cadmium compound gave 0·207 cubic inch of nitrogen with no admixture of hydrogen. A like weight of the copper compound gave 0·107 of nitrogen. No ammonia was evolved from either; and the author is inclined to think that the hydrogen yielded by the zinc compound resulted from the reaction of the metal upon combined water. The specific gravity of specimens of these substances which the author tried were respectively 4, 6, 4, 8, and 5, 9. A mixed solution of chloride of gold and hydrochlorate of ammonia, electrolyzed with platinum electrodes, gave a black powder of the specific gravity 10·3; five grains of which, being heated, gave only 0·05 cubic inch of gas. The author proceeds to observe, that the similarity in appearance and mode of formation of these compounds and of the mercurio-ammoniacal amalgam, is strong evidence of identity of constitution, and that the non-permanence of the latter substance is due to the mobility of the mercury; for if we place the compounds in similar circumstances, that is, solidify the mercurial one, or liquefy those of the other metals, the phænomena are perfectly analogous. The experiments also bear immediately upon those of Thénard, Savart, and others, where ammonia, passed over heated metals, was found to be decomposed more completely by the oxidable than by the inoxidable metals, and to alter their physical characters without materially increasing their weight. On examining papers connected with this subject, the author found that Mr. Daniell had cursorily noticed a deposit somewhat analogous to those here treated of, which was formed upon the negative plate of his constant battery when this was charged on the zinc side with hydrochlorate of ammonia, and the nature of which that gentleman observed was worthy of further examination, but had not had time to investigate.

February 11, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The Right Hon. Sir Richard Hussey Vivian, Bart., G.C.B., &c., and Samuel Cartwright, Esq., were balloted for, and duly elected into the Society.

A paper was read, entitled, "Contributions to Terrestrial Magnetism, No. 2." By Major Edward Sabine, R.A., V.P.R.S.

This paper is the second of a series, in which the author purposes to communicate to the Royal Society the results of magnetic observations in different parts of the globe, having for their object to

supply the requisite data for deducing the numerical elements corresponding to the present epoch of the general theory of terrestrial magnetism. It consists of two sections; the first comprises the observations of Captain Belcher, R.N., and the officers of H. M. S. Sulphur, at twenty-nine stations on the west coast of America, and the adjacent islands, between the latitudes of 60° 21′ N. and 18° 05′ S. The second contains a new determination, by the same officers, of the magnetic elements at Otaheite, made in consequence of the discrepancies in the results obtained by previous observers, and of a note in M. Gauss's Allgemeine Theorie, in which Otaheite is spoken of as a highly important station for the future improvement of the calculations of the theory. Abstracts are given of the original observations which are deposited in the Hydrographic Office of the Admiralty, as well as a full detail of the processes of reduction by which their results have been computed. The values of the horizontal and total intensities are expressed in terms by which the results of observation are immediately comparable with the maps of MM. Gauss and Weber in the " Atlas des Erdmagnetismus."

By an investigation into the " probable error " of a single independent determination of the magnetic intensity with Hansteen's apparatus, derived from the data furnished by Captain Belcher's observations, the author shows the extreme improbability that the differences in the results obtained at Otaheite by Messrs. Erman, FitzRoy and Belcher, should be occasioned by instrumental or observational error. They are also far greater than can, with any degree of probability, be ascribed to periodical or accidental variations in the magnetic force from its mean value. The only known cause adequate to their explanation is what may with propriety be termed *Station error*; that is, local disturbing influences, in an island composed chiefly of volcanic rocks, and where the spot of observation selected by the different observers may not have been precisely the same.

By a reference to the magnetic survey of the British Islands, the occurrence of station error is shown to be frequent in countries of far less decided igneous character than Otaheite; and that its existence may always be apprehended where rocks of that nature approach to, or rise through, the superficial soil. The absolute determinations of fixed observatories are as liable to station error as those of the magnetic traveller, since no continuance or repetition of the observations can lead to an elimination of the error; it consequently presents a practical difficulty to the proposed determination of the elements of the theory from exact observation at only a few selected positions on the globe. The remedy is to be found in the combination of fixed observatories and magnetic surveys: the observations of the survey, being made in concert with, and based on those of the fixed observatory, will be furnished thereby with corrections for the secular, periodical, and accidental variations of the elements, and will consequently determine *mean* values: and a proper combination of the mean values thus determined, over a space sufficiently extensive

to neutralize *district* anomalies, as well as those of a more strictly local character, will furnish, in their turn, a correction for the station error, if any, of the fixed observatory.

A paper was also read, entitled, "On the Calculation of Attractions, and the Figure of the Earth." By C. J. Hargreave, B.A., of University College. Communicated by John T. Graves, M.A., F.R.S., Professor of Jurisprudence, University College, London.

The principal object of the calculations contained in this paper is to investigate the figure which a fluid, consisting of portions, varying in density according to any given law, would assume, when every particle is acted upon by the attraction of every other, and by a centrifugal force arising from rotatory motion. That such has been the original condition of the earth has been assumed as the foundation of most of the mathematical calculations connected with this inquiry; although the hypothesis itself may admit of doubt. The principal difficulty of this problem consists in the computation of the attraction of a body of any given figure, and composed of strata varying in their densities according to any given law. In solving it, the author follows the steps of Laplace as far as the point where the equation, known by his name, first appears. It has, however, since been discovered by Mr. Ivory, that the theorem of Laplace is true only of spheroids of a particular kind, and consequently it is to this kind that Laplace's solution of the problem is restricted. The method given in the present paper is not confined in its operation to any particular class of spheroids; the coefficients of the series into which the required function is developed being determined absolutely, and without reference to the form of the spheroid to which they are to be applied. The principal change consists in the different manner of treating the partial differential equation; and its integration, effected by the author, renders the analysis more direct, the operations more simple, and the theory complete.

February 18, 1841.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Sir Richard Jenkins, G.C.B., &c., John Clendinning, M.D., and Eaton Hodgkinson, Esq., were balloted for, and duly elected into the Society.

A paper was in part read, entitled, "Memoir on a portion of the Lower Jaw of an Iguanodon, and other Saurian Remains discovered in the strata of Tilgate Forest, in Sussex." By Gideon Algernon Mantell, Esq., LL.D., F.R.S.

February 25, 1841.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P., and Treasurer, in the Chair.

The Right Honourable Lord Viscount Melbourne, and the Rev. Mark Aloysius Tierney, were balloted for, and duly elected into the Society.

The reading of a paper, entitled, "Memoir on a portion of the Lower Jaw of an Iguanodon, and other Saurian Remains discovered in the strata of Tilgate Forest, in Sussex." By Gideon Algernon Mantell, Esq., LL.D., F.R.S., was resumed and concluded.

When the author communicated to the Royal Society, in the year 1825, a notice on the teeth of an unknown herbivorous reptile, found in the limestone of Tilgate Forest, in Sussex, he was in hopes of discovering the jaws, with the teeth attached to it, of the same fossil animal, which might either confirm or modify the inferences he had been led to deduce from an examination of the detached teeth. He was, however, disappointed in the object of his search until lately, when he has been fortunate enough to discover a portion of the lower jaw of a young individual, in which the fangs of many teeth, and the germs of several of the supplementary teeth, are preserved. The present paper is occupied with a minute and circumstantial description of these specimens, and an elaborate inquiry into the osteological characters and relations presented by the extinct animals to which they belonged, as compared with existing species of Saurian reptiles; the whole being illustrated by numerous drawings. The comparison here instituted furnishes apparently conclusive proof that the fossil thus discovered is a portion of the lower jaw of a reptile of the Lacertine family, belonging to a genus nearly allied to the Iguana. From the peculiar structure and condition of the teeth it appears evident that the *Iguanodon* was herbivorous; and from the form of the bones of the extremities it may be inferred that it was enabled, by its long, slender, prehensile fore-feet, armed with hooked claws, and supported by its enormous hinder limbs, to pull down and feed on the foliage and trunks of the arborescent ferns, constituting the flora of that country, of which this colossal reptile appears to have been the principal inhabitant.

Some particulars are added respecting various other fossil bones found in Tilgate Forest, and in particular those of the *Hylæosaurus*, or Wealden Lizard (of which genus the author discovered the remains of three individuals), and of several other reptiles, as the *Megalosaurus*, *Plesiosaurus*, and several species of *Steneosaurus*, *Pterodactylus*, and other Chelonia, as also one or more species of a bird allied to the Heron. All these specimens are now deposited in the British Museum.

A paper was also read, entitled, "On a Theorem of Fermat." By Sir John William Lubbock, Bart., V.P., and Treas. R.S.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1841. No. 47.

March 4, 1841.

MAJOR SABINE, R.A., V.P., in the Chair.

Robert William Sievier, Esq., was balloted for, and duly elected into the Society.

A paper was read, entitled, "Miscellaneous Observations on the Torpedo." By John Davy, M.D., F.R.S.

The experiments described in this paper were made on a single fish, of middle size, recently taken out of the water. Portions of the electrical organs, cut transversely in thin slices, exhibited under the microscope many elliptical particles, apparently blood-corpuscles, the long diameter of which was about 1-800th, and the short about 1-1000th of an inch, and a few filaments, apparently nervous, irregularly scattered; some of them tortuous, and all about the 2000th of an inch in diameter. The latter bore no resemblance to muscular fibres. The blood contained some globular particles, having a diameter of the 4000th of an inch, mixed with the elliptical. The mucus for lubricating the surface was found to contain globules apparently homogeneous in substance, but of irregular outline, and in size varying from the 2000th to the 270th of an inch.

A paper was also read, entitled, " On a remarkable property of the Diamond." By Sir David Brewster, K.H., D.C.L., F.R.S.L., V.P.R.S. Ed.

On re-examining the phenomena of parallel bands of light and shade exhibited by reflexion at the plane surface of a diamond, which the author had noticed some years ago, he concludes that they result from the reflexions of the edges of veins or laminæ, of which the visible terminations are inclined at different angles, not exceeding two or three seconds, to the general surface. He gives an account of several analogous facts observable in other crystals, more especially those of carbonate of lime, artificially polished in surfaces inclined to the natural planes of cleavage.

March 11, 1841.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair.

The following papers were read:

1. "On a Cycle of Eighteen Years in the Mean Annual Height of the Barometer in the Climate of London; and on a Constant Variation of the Barometrical Mean, according to the Moon's Declination." By Luke Howard, Esq., F.R.S.

For obtaining the general results communicated in the present paper, the author has followed the same method as that he had adopted in the two former papers laid before the Society on the connexion of the barometrical variation with the lunar phases and apsides. Tables are given of the barometrical averages on successive solar years, from 1815 to 1832, so constructed as to exhibit the variation of the moon's influence according to her declination; and also of these averages on successive cycles of nine solar years, classed according to the moon's place in declination, on either side of the equator. The results deduced from these comparisons are, first, that the barometrical mean in this climate is depressed by the moon's declination being to the south of the equator; and, secondly, that this depression takes place gradually, commencing with the moon's being in full north declination, and proceeding through her remaining positions to the time when she crosses the equator to resume the northern declination; at which season, the whole pressure that had been withdrawn from the atmosphere is suddenly restored. The author thinks there is evidence of a great tidal wave, or swell in the atmosphere, caused by the moon's attraction, preceding her in her approach to, and following her slowly as she recedes from these latitudes; so that were the atmosphere a calm fluid ocean of air, of uniform temperature, this tide would be manifested with as great regularity as those of the ocean of waters. But the currents uniformly kept up by the sun's varying influence effectually prevent this from taking place, and involve the problem in complexity. He finds that there is also manifested in the lunar influence a gradation of effect, which operates through a cycle of eighteen years. The mean pressure of the atmosphere during the first part of this period increases; and then, after preserving for a year its maximum amount, again decreases through the remaining years of the cycle, but exhibits, towards its minimum, some fluctuations before it again regularly increases.

2. "On a remarkable depression of the Barometer in November 1840, agreeing very closely in its movements and results with that of December 1821." By Luke Howard, Esq., F.R.S.

The object of the author in the present paper is to show the close correspondence of the extraordinary depression of the barometer in the months of October and November of last year (1840), and of the remarkably stormy weather which prevailed at the same period,

with similar phenomena occurring in December 1821, when the moon's place in declination underwent the same changes during those two periods, at an interval of nineteen years.

3. "General results of Meteorological Observations at Constantinople." By J. W. Redhouse, Esq. Communicated by John Davy, M.D., F.R.S.

4. "Term-Observations made at Prague in November and December 1840, and January 1841." By C. Kreil. Communicated by S. Hunter Christie, Esq., M.A., Sec. R.S.

March 18, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The Right Hon. Thomas Frankland Lewis, and Robert Masters Kerrison, M.D., were balloted for, and severally elected into the Society.

The following Magnetical and Meteorological Observations, taken in conformity with the Report drawn up by the Committee of Physics including Meteorology, for the guidance of the Antarctic Expedition, as also for the various fixed Magnetic Observatories, have been communicated by the Lords Commissioners of the Admiralty, and by the Master-General of the Ordnance, viz.—

1. "Magnetic-term Observations, taken at Kerguelen's Land, for May and June 1840." By Capt. James Clark Ross, R.N., F.R.S., Commander of the Expedition.

2. "Hourly Magnetic Observations taken at Kerguelen's Land, commencing May 25, and ending June 27, 1840." By Capt. James Clark Ross, R.N., F.R.S., &c.

3. "Meteorological Observations taken on board Her Majesty's Ship *Erebus*, for October, November, and December 1839, and from January to August 1840." By Capt. James Clark Ross, R.N., F.R.S., &c.

4. "Meteorological Observations taken on board Her Majesty's Ship *Terror*, for November and December 1839, and from January to July 1840." By Capt. T. B. M. Crozier, R.N.

5. A paper was also in part read, entitled, "On the Localities affected by Hoar-frost, the peculiar currents of Air excited by it, and the Temperature during its occurrence at High and Low Stations." By James Farquharson, LL.D., F.R.S., Minister of the Parish of Alford.

March 25, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following communications were read, viz.—

1. The reading of a paper entitled, "On the Localities affected by Hoar-frost, the peculiar currents of Air excited by it, and the Temperature during its occurrence at High and Low Stations." By James Farquharson, LL.D., F.R.S., Minister of the Parish of Alford, was resumed and concluded.

The author states that he has becn accustomed, for the last forty years, to make observations on the occurrence of hoar-frost, and the circumstances under which it takes place, with a view of obtaining a correct explanation of the causes of that phenomenon. It is well-known, he observes, that the localities chiefly affected with hoar-frost are the bottoms of valleys, and land-locked places of all kinds, whether natural or artificial. The altitude to which its effects reach on the sides of the valleys is dependent on the mean temperature of the day and night at the time of its occurrence: when that temperature is high, the lower places only are affected by the frost; but when low, the frost extends to much higher grounds. Hoar-frost occurs only during a calm state of the air, and when the sky is clear; but the stillness of the air in the bottoms of the valley is invariably accompanied by downward currents of air along all the sloping sides of the valley; and it is to this fact, first noticed by the author, that he wishes more particularly to direct the attention of the Society, as affording a decisive proof of the correctness of the views he entertains, being in accordance with the theory of Dr. Wells. He finds that after sunset, in all seasons of the year, and at all mean temperatures of the air, and whether or not the ground be covered with snow, whenever the sky is clear, although there may be a dead calm at the bottoms of the valleys, currents of air, more or less strong and steady, run downwards on the inclined lands, whatever may be their aspect with reference to the points of the compass. These currents are the result of the sudden depression of temperature sustained by the surface of the earth in consequence of rapid radiation, by which the stratum of air in immediate contact with that surface, becoming specifically heavier by condensation, descends into the valley, and is replaced by air which has not been thus cooled, and which therefore prevents the formation of hoar-frost on the surface of these declivities.

2. "Term-Observations of Magnetic Observations, the Variation of the Magnetic Declination, Horizontal Intensity and Inclination at Prague; for June, July, September, and October 1840." By Prof. Kreil. Communicated by S. Hunter Christie, Esq., Sec. R.S.

3. "Term-Observations of the Variation of the Magnetic Declination, Horizontal Intensity and Inclination at Milan; for June 1840." By Francesco Carlini, For. Memb. R.S., Director of the Observatory.

4. "On Ground-gru, or ice formed, under peculiar circumstances, at the bottom of running water." By James Farquharson, LL.D., F.R.S., Minister of the Parish of Alford.

The author brings forward in this paper several recent observations on the formation of ice at the bottom of rivers, the conditions of which corroborate the views regarding the cause of that phenomenon, which he presented in a paper on this subject, published in the Philosophical Transactions for 1835 (p. 329), namely, that it occurs in consequence of the loss of heat by radiation from the bottom of the water, in a manner precisely analogous to the formation of hoar-frost on the surface of dry land, as first explained by Dr. Wells. He then answers some of the objections to that theory propounded in an article, under the title of Ground-Gru, in the Penny Cyclopædia, and shows that those objections are founded in error, and possess no validity.

5. "Meteorological Observations made at the Magnetic Observatory at St. Helena, from February to October 1840." By Lieut. J. H. Lefroy, R.A.

6. "Meteorological Observations made at the Magnetic Observatory at Toronto, Upper Canada, from January to October 1840." By Lieut. E. J. B. Riddell, R.A.

7. "Observations on Magnetic Direction and Intensity made at the Observatory at Milan during the 24th, 26th and 27th of January 1841." By Prof. Carlini.

8. "Note on an irregularity in the Height of the Barometer, of which the argument is the Declination of the Moon." By Sir John William Lubbock, Bart., V.P. and Treas. R.S.

In the Companion to the British Almanac for 1839, the author inserted some results which were obtained with a view of ascertaining the influence of the moon on the barometer and on the dew-point. Mr. Luke Howard's researches on this subject having recalled his attention to that paper, he found that some of the results he had given appeared to indicate that the moon's position in declination influences the barometer. In order to render this more manifest, he combines in the present paper all the observations he gave in the Companion to the British Almanac in three categories. These observations correspond to different angular distances of the moon from the sun, or times of transit; but as the inequality of the ocean, of which the argument is the moon's declination, is independent, or very nearly so, of the time of the moon's transit, it is probable that so also is that in the height of the barometer. In this case we may with propriety combine in the same category observations which correspond to similar declinations, although to different times of transit. The results stated by the author seem to indicate an elevation of nearly one-tenth of an inch for 17 degrees of declination.

The inequality has a contrary sign to the inequality of the same argument in the tides of the ocean.

April 1, 1841.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Bartholomew Parker Bidder, Esq., and Julian Jackson, Esq., were balloted for, but not elected into the Society.

The following letter, addressed to the President, was read:—

"4, Trafalgar Square,
London, March 25th, 1841.

"MY LORD,—I have the honour of transmitting to Your Lordship for presentation to the Royal Society, an original portrait of *Sir Isaac Newton* by *Vanderbank*, a Dutch painter of some note in that age.

"This picture has now been many years in my possession, and the tenure by which I have kept it (as a collateral descendant of so illustrious a man) was too flattering not to have been a source of great personal gratification.

"But I consider such a portrait to belong of right to the scientific world in general, and more especially to that eminently distinguished Society of which Newton was once the head, and which is now so ably presided over by Your Lordship.

"I have, therefore, to request Your Lordship will do me the honour to present this original portrait of Sir Isaac Newton to the Royal Society in my humble name.

"Accident having destroyed some of the papers of my family, I am unable of myself to trace the entire history of this portrait, but I believe more than one member of the Royal Society is competent to do so, and it is well known to collectors; and a small mezzotinto engraving of it was published about forty years ago. It was painted the year before Newton died, and came into the family of the celebrated Lord Stanhope, who left it by his will to my grandfather, the late Dr. Charles Hutton, a distinguished member of the Royal Society, expressly on the well-authenticated account of that eminent mathematician having been remotely descended from Sir Isaac Newton, in the following way, as I find on a family manuscript; viz. 'that the mother of the well-known James Hutton and the mother of Dr. Charles Hutton were sisters; and the grandmother of James Hutton and the mother of Sir Isaac Newton were also sisters.'

"I have ever considered this very distant connexion with so great a man should not be an inducement to lead me into any but casual mention of the circumstance, that I might avoid the imputation of a vain boast; nor would it have been brought forward now, except

to explain the cause by which this portrait came into the possession of an individual who is happy in relinquishing it to grace the Hall of Meeting of the Royal Society.

"I have the honour to subscribe myself,

"Your Lordship's very obedient humble Servant,

"CHARLES VIGNOLLES."

"*The Right Honourable the Marquess of Northampton,*

&c. &c. &c.

President of the Royal Society."

The following papers were read, viz.—

1. "A Meteorological Journal for 1840, kept at Allenheads, Northumberland, with a few remarks on the Rain-gauge." By the Rev. W. Walton, F.R.S.

The author shows that if the mouth of a rain-gauge be placed in any plane which is not perfectly horizontal, the results will be liable to inaccuracy, whatever may be the direction in which the rain falls. He thinks that, on many occasions, the drops of rain diminish in their size during their descent on entering warmer regions of the atmosphere, so as finally to disappear.

2. "The Scholar's Lute among the Chinese." By — Lay, Esq. Communicated by S. H. Christie, Esq., Sec. R.S.

The Kin, which is the stringed instrument here described, was the one played upon by Confucius and the sages of antiquity, and is therefore held sacred by men of letters. It is made of the Woo-tung, or *Dryandria cordifolia*. It is convex above and plane below, and is wider at one end than at the other; it has two quadrangular apertures in the plane surface, which open into as many hollows within the body of the instrument: and it is furnished with seven silken strings of different diameters, which pass over the smaller end, and are distributed between two immovable pegs below. A bridge within a short distance of the wider extremity gives these strings the necessary elevation and a passage to the under surface, where, by means of a row of pegs, they are tightened or relaxed at pleasure. The length of the sounding-board is divided by thirteen studs of nacre, or mother-of-pearl, as a guide for the performer; and they are placed so that the length of each string is bisected, trisected, &c., that is, divided into aliquot parts as far as the eighth subdivision, with the omission of the seventh, the number of sections being represented by the arithmetical series

2, 3, 4, 5, 6, 0, 8.

Thus the intervals, or magnitudes of the different tones sounded by this instrument, do not accord with those produced on our violin, but agree more with the old Scotch music. The study of this instrument, and the art of playing upon it, are rendered extremely difficult by the complexity of the Chinese notation of written music, which leads to frequent omissions and blunders. Thus every air which a Chinese plays has cost him the labour of many months to learn; and so tiresome is this acquisition, that the author has heard

some extemporize very prettily without being able to play a single air. Their performance, however, is very graceful; and though the melody be simple, every scope is given to variety by the mode of touching the strings. The author enters into an examination of the musical theory of the sounds produced by this instrument.

The Society then adjourned over the Easter Recess, to meet again on the 22nd instant.

April 22, 1841.

The MARQUIS of NORTHAMPTON, President, in the Chair.

William Bowman, Esq., was balloted for and duly elected into the Society.

The following papers were read, viz.—

1. Magnetic-term Observations taken on board H.M.S. Erebus and Terror, at Hobart Town, on the 29th and 30th August, and the 23rd and 24th September, 1840, by, and under the direction of James Clark Ross, Captain R.N., F.R.S., and Commander of the Antarctic Expedition.

2. Magnetic-term Observations made at the fixed Magnetic Observatory, Van Diemen's Land, on the 28th, 29th and 30th August, and the 23rd and 24th September, 1840; by James Clark Ross, Captain R.N., F.R.S., Commander of the Antarctic Expedition.

3. Hourly Magnetic Observations for August and September, 1840, taken at the Ship's Magnetic Observatory, Van Diemen's Land, under the direction of James Clark Ross, Captain R.N., F.R.S., Commander of the Artarctic Expedition.

The above papers were communicated by the Lords Commissioners of the Admiralty.

4. Variation de la déclinaison, intensité horizontal et inclinaison magnétique, observés à Milan, pendant vingt-quatre heures de suite, le 24 et 25 Fevrier et Mars, 1841, par Signior Carlini, Forn. Memb. R.S.

5. "Remarks on the Birds of Kerguelen's Land." By R. McCormick, Esq., Surgeon R.N. of H.M.S. Erebus. Communicated by the Lords Commissioners of the Admiralty

The birds usually met with by the author in this island were petrels and penguins; and besides these, he found two species of gull, a duck, a shag, a fern, a small albatros, and a species of Chionis; and also a remarkable nocturnal bird allied to the Procellaria. Brief notices are given of the forms and habits of these birds.

6. "Geological Remarks on Kerguelen's Land." By R. McCormick, Esq., Surgeon R.N. of H.M.S. Erebus. Communicated by the Lords Commissioners of the Admiralty.

The northern extremity of the island is described as being entirely of volcanic origin. The trap rocks, of which the headlands are composed, form a succession of terraces nearly horizontal. Basalt is the prevailing rock: it assumes the prismatic form, and passes into greenstone, and the various modifications of amygdaloid and porphyry. The general direction of the mountain-ranges inclines to the south-west and north-east, and they vary in height from 500 to 2500 feet. Many of the hills are intersected by trap dykes, usually of basalt. Several conical hills, with crater-shaped summits, are found, evidently the remains of volcanic vents. Three or four very singular isolated hills, composed of an igneous slaty sandstone, occur in Cumberland Bay, presenting very smooth outlines, and consisting of piles of broken fragments, through which the mass protrudes, in places, in prismatic columns. Vast quantities of *débris* are accumulated at the base of the hills, in many places to the height of 200 or 300 feet or more, affording strong evidence of the rapid disintegration this land is undergoing, from the sudden atmospheric vicissitudes to which it is exposed.

The whole island is deeply indented by bays and inlets, and its surface intersected by numerous small lakes and water courses. These, becoming swollen by the heavy rains, which alternate with frost and snow, rush down the sides of the mountains and along the ravines in countless impetuous torrents, forming, in many places, beautiful foaming cascades, wearing away the rocks, and strewing the platforms and valleys below with vast fragments of rocks and slopes of rich alluvium, the result of their decomposition.

The most remarkable geological feature in the island is the occurrence of fossil wood and coal, and what is still more extraordinary, these are imbedded in the igneous rocks. The wood, which is for the most part highly silicified, is found enclosed in the basalt; whilst the coal crops out in ravines, in close contact with the overlying porphyritic and amygdaloidal greenstone.

A few outline sketches of the rocks and scenery, in various parts of the island, accompany this paper.

A paper was also in part read, entitled, "On the proportion of the prevailing Winds, the mean Temperature, and depth of Rain in the climate of London, computed through a cycle of eighteen years, or periods of the Moon's Declination." By Luke Howard, Esq., F.R.S.

April 29, 1841.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair.

The Right Honourable Lord Monteagle, the Right Honourable Earl de Grey, the Right Honourable Lord Wrottesley, and Charles Woodward, Esq., were balloted for and duly elected into the Society.

The following papers were read, viz.—

1. "On the proportions of the prevailing Winds, the mean Temperature, and depth of Rain in the climate of London, computed through a cycle of eighteen years, or periods of the Moon's Declination." By Luke Howard, Esq., F.R.S., was resumed and concluded.

In this paper the author investigates the periodical variations of the winds, rain and temperature, corresponding to the conditions of the moon's declination, in a manner similar to that he has already followed in the case of the barometrical variations, on a period of years extending from 1815 to 1832 inclusive. In each case he gives tables of the average quantities for each week, at the middle of which the moon is in the equator, or else has either attained its maximum north or south declination. He thus finds that a north-east wind is most promoted by the constant solar influence which causes it, when the moon is about the equator, going from north to south; that a south-east wind, in like manner, prevails most when the moon is proceeding to acquire a southern declination; that winds from the south and west blow more when the moon is in her mean degrees of declination, going either way, than with a full north or south declination; and that a north-west wind, the common summer and fair weather wind of the climate, affects, in like manner, the mean declination, in either direction, in preference to the north or south, and most when the moon is coming north.

He finds the average annual depth of rain, falling in the neighbourhood of London, is 25·17 inches.

From his observations on the temperature, he deduces the following conclusions:—1. That the pressure of an atmospheric tide, which attends the approach of the moon to these latitudes, raises the mean temperature 0·35 of a degree. 2. That the rarefaction under the moon in north declination lowers the temperature 0·13 of a degree. 3. That the northerly swell following the moon as she recedes to the south further cools the air 0·18 of a degree. 4. That this cold continues while the moon is away south, reducing the mean temperature yet lower by 0·04 of a degree.

2. "A new Method of solving Numerical Equations." By Mr. Thomas Weddle, of Stamfordham. Communicated by S. H. Christie, Esq., M.A., Sec. R.S.

The object of this paper is to develope a new and remarkably simple method of approximating to the real roots of numerical equations, which possesses several important advantages. After describing the nature of the transformations which are subsequently

employed, the author proceeds to develppe the process he uses for obtaining one of the roots of a numerical equation. Passing over the difficult question of determining the limits of the roots, he supposes the first significant figure (R) of a root to have been ascertained, and transforms the proposed equation into one whose roots are the roots of the original, divided by this figure $\left(\text{or } \frac{x}{R}\right)$: one root of this equation lying between 1 and 2, the first significant figure (r) of the decimal part is obtained, and the equation transformed into another whose roots are those of the former, divided by 1 + this decimal (or $1+r$). This last equation is again similarly transformed; these transformations being readily effected by the methods first given. Proceeding thus, the root of the original equation is obtained in the form of a continued product. After applying this method to finding a root of an equation of the 4th, and likewise one of the 5th degree, the author applies it to a class of equations to which he considers it peculiarly adapted, namely, those in which several terms are wanting. One of these is of the 16th degree, having only six terms; and another is of the 622nd degree, having only four terms.

3. "Additional Note on the Contraction of Voluntary Muscles in the living body." By William Bowman, Esq., F.R.S., Demonstrator of Anatomy in King's College, London, and Assistant Surgeon to King's College Hospital.

This communication contains a short account of some recent examinations made by the author on the human muscular fibre affected by tetanus. The effect of the violent contractions which characterize this disease, is to produce, in many parts of the muscles, considerable ecchymosis, which gives the contiguous portions a pale and gray aspect. In other places the muscles lose, in a great measure, their fine fibrous character, and exhibit a soft mottled surface, which is easily torn. The primitive fasciculi, when microscopically examined, present indications of strong contraction, appearing swollen into a fusiform shape, and having their transverse striæ in some parts much more closely approximated, and in others separated to much greater distances than in the natural state, or even altogether obliterated, in consequence of the whole texture being broken up into those primitive elements of which the discs are constructed; and frequently they are broken across without a corresponding rupture of the sarcolemma.

The author is led from his observations to the conclusions,—1st, that the contraction of a muscle is the essential cause of its rupture, 2ndly, that there is no repellent force between the contractile elements of muscular fibre; and, lastly, that the contraction of voluntary muscle is not a sustained act of the whole congeries of contractile elements composing it, but a rapid series of partial acts, in which all duly share, becoming by turns contracted and relaxed.

The paper is accompanied by drawings cf the microscopic appearances therein described.

May 6, 1841.

Sir JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

The Right Honourable George Stevens Byng, M.P., was balloted for and duly elected into the Society.

The following papers were read, viz.—

1. "Investigation of a New and Simple Series, by which the Ratio of the Diameter of a Circle to its Circumference may easily be computed to any required degree of accuracy." By William Rutherford, Esq., of the Royal Military Academy, Woolwich. Communicated by Samuel Hunter Christie, Esq., M.A., Sec. R.S.

Among various formulæ for the rectification of the circle discovered by the author, he has found the one given in this paper to be that best fitted for computation: and he has been enabled by means of it, with comparatively little labour, to extend the number, expressing the ratio of the diameter to the circumference, to 208 places of decimals, a degree of accuracy hitherto unattainable, without a great amount of labour, by means of any of the series which have yet been employed.

The celebrated series of Mr. John Machin, for the rectification of the circle, is derived from the formula

$$\frac{\pi}{4}=4\tan^{-1}\frac{1}{5}-\tan^{-1}\frac{1}{239},$$

which converges with considerable rapidity, but gives rise to tedious computations, in consequence of the divisor 239 being a prime number. But by converting the above formula into the following,

$$\frac{\pi}{4}=4\tan^{-1}\frac{1}{5}-\tan^{-1}\frac{1}{70}+\tan\ \frac{1}{99},$$

a series is obtained by which the extended computation above mentioned was readily effected.

The methods of computation are then stated in detail, and the resulting value of π is given to 208 places of decimals, which is presumed to be accurate to the last figure, the computations having been actually carried as far as 210 figures.

2. "On the Phenomena of thin plates of Solid and Fluid Substances exposed to polarised light." By Sir David Brewster, K.H., D.C.L., F.R.S., & V.P.R.S. Ed.

From a theoretical investigation of the phenomena described in this paper, the author deduces the important law, that when two polarized pencils, reflected from the surface of a thin plate, lying on a reflecting surface of a different refractive power, interfere, half an undulation is not lost, and white-centred rings are produced. When the inclination is exactly 90°, the pencils do not interfere, and no rings are produced.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1841. No. 48.

May 13, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Robert Liston, Esq., and Henry Harpur Spry, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Meteorological Observations for August, September, and October, 1840, taken on board H.M.S. *Erebus* and *Terror*, by and under the direction of Capt. James Clark Ross, R.N., Commander of the Antarctic Expedition." Presented by the Lords Commissioners of the Admiralty, and communicated by the President of the Royal Society.

2. "Hourly Meteorological Observations made at Plymouth, in latitude 52° 36′ 12″, longitude in time 6^{m} 55^{s} east, on the 22nd of March, 1841." By Arthur Utting, Esq. Communicated by Capt. Edward Johnson, R.N., F.R.S.

3. "Barometrical Observations taken at Naples at 9 A.M. on each day during the months of January and February, 1841." By Sir Woodbine Parish, K.C.H., F.R.S. Presented by direction of the Council of the Royal Geographical Society, and communicated by S. H. Christie, Esq., Sec. R.S.

4. "Memoir of the case of a gentleman born blind, and successfully operated upon in the eighteenth year of his age; with Physiological Observations and Experiments." By J. C. August Franz, M.D., M.R.C.S. Communicated by Sir Benjamin C. Brodie, Bart., F.R.S.

The young gentleman who is the subject of this memoir had been affected from birth with strabismus of both eyes; the right eye was amaurotic, and the left deprived of sight by the opacity both of the crystalline lens and of its capsule. At the age of seventeen, an operation for the removal of the cataract of the left eye was performed by the author with complete success. On opening the eye for the first time, on the third day after the operation, the patient described

his visual perception as being that of an extensive field of light, in which everything appeared dull, confused, and in motion, and in which no object was distinguishable. On repeating the experiment two days afterwards, he described what he saw as a number of opake watery spheres, which moved with the movements of the eye, but when the eye was at rest remained stationary, and their margins partially covering one another. Two days after this the same phenomena were observed, but the spheres were less opake and somewhat transparent; their movements were more steady, and they appeared to cover each other more than before. He was now for the first time capable, as he said, of looking through these spheres, and of perceiving a difference, but merely a difference, in the surrounding objects. The appearance of spheres diminished daily; they became smaller, clearer, and more pellucid, allowed objects to be seen more distinctly, and disappeared entirely after two weeks. As soon as the sensibility of the retina had so far diminished as to allow the patient to view objects deliberately without pain, ribands differently coloured were presented to his eye. These different colours he could recognize, with the exception of yellow and green, which he frequently confounded when apart, but could distinguish when both were before him at the same time. Of all colours, gray produced the most grateful sensation: red, orange and yellow, though they excited pain, were not in themselves disagreeable; while the effect of violet and of brown was exactly the reverse, being very disagreeable, though not painful. Brown he called an ugly colour: black produced subjective colours; and white gave rise to a profusion of *muscæ volitantes*. When geometrical figures of different kinds were offered to his view, he succeeded in pointing them out correctly, although he never moved his hand directly and decidedly, but always as if feeling with the greatest caution. When a cube and a sphere were presented to him, after examining these bodies with great attention, he said that he saw a quadrangular and a circular figure, and after further consideration described the one as being a square, and the other a disc, but confessed that he had not been able to form these ideas until he perceived a sensation of what he saw in the points of his fingers, as if he really touched the objects. Subsequent experiments showed that he could not discriminate a solid body from a plane surface of similar shape; thus a pyramid placed before him, with one of its sides towards his eye, appeared as a plane triangle.

Two months after the above-mentioned operation, another was performed on both eyes, for the cure of the congenital strabismus, by the division of the tendons of the recti interni muscles, which produced a very beneficial effect on the vision of the left eye; and even the right eye, which had been amaurotic, gained some power of perceiving light, and, from being atrophied, became more prominent. Still it was only by slow degrees that the power of recognizing the true forms, magnitudes, and situations of external objects was acquired. In course of time, the eye gained greater power of converging the rays of light, as was shown by the continually increasing capacity of distinct vision by the aid of spectacles of given powers.

May 20, 1841.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair.

Hart Davis, jun., Esq., the Rev. Joshua Frederick Denham, M.A., the Rev. John Hoppus, LL.D., Henry Gally Knight, Esq., M.P., and Lieut.-Colonel Thomas Wood, M.P., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Catalogue of Geological Specimens procured from Kerguelen's Land during the months of May, June, and July, 1840."

2. "Catalogue of Birds collected on board Her Majesty's Ship *Terror*, between the Cape of Good Hope and Van Diemen's Land."

3. "Description of Plants from Kerguelen's Land, collected in May, June, and July, 1840."

The above papers are by John Robertson, Esq., Surgeon of Her Majesty's Ship *Terror*, and were presented to the Society by the Lords Commissioners of the Admiralty, and communicated by the President of the Royal Society.

4. "On the Fossil Remains of Turtles discovered in the Chalk Formation of the South-East of England." By Gideon Algernon Mantell, Esq., LL.D., F.R.S.

In this paper the author gives a description, accompanied with drawings, of a remarkable fossil Turtle, referable to the genus *Emys*, and named from its discoverer, Mr. Bensted, the *Emys Benstedi*, which has been lately found in a quarry of the lower chalk of Kent, at Burham, which is situated near the banks of the Medway, between Chatham and Maidstone. The specimen discovered consists of the carapace or dorsal shell, six inches in length and nearly four inches in breadth, with some of the sternal plates, vertebræ, eight ribs on each side of the dorsal ridge, a border of marginal plates, and one of the coracoid bones. It is adherent to a block of chalk by the external surface of the sternal plates. The marginal plates are joined to each other by finely indented sutures, and bear the impress of the horny scales or tortoise-shell, with which they were originally covered. The expanded ribs are united together throughout the proximal half of their length, and gradually taper to their marginal extremities, which are protected by the plates of the osseous border. Mr. Bell considers the species to which it belonged as being closely allied in form to the common European Emys, and as possessing a truly fluviatile or lacustrine character. The plates of the plastron, however, as also the coracoid bone, resemble more the corresponding bones of marine than of freshwater turtles.

5. " Researches tending to prove the Non-vascularity of certain Animal Tissues, and to demonstrate the peculiar uniform mode of their Organization and Nutrition." By Joseph Toynbee, Esq. Communicated by Sir Benjamin Brodie, Bart., F.R.S., &c.

The above was only in part read.

May 27, 1841.

SIR JOHN BARROW, Bart., V.P., in the Chair.

The Right Honourable the Earl of Carnarvon, and Ardaseer Cursetjee, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. " On the Compensations of Polarized Light, with the description of a Polarimeter for Measuring Degrees of Polarization." By Sir David Brewster, K.H., D.C.L., F.R.S., and V.P.R.S. Ed.

In four papers published in the Philosophical Transactions for 1830, the author maintained, in opposition to the prevailing theory, that light either reflected or refracted at angles different from that at which it is completely polarized, does not consist of two portions, one completely polarized, and the other completely unpolarized, but that every portion of it has the same physical property, having approximated in an equal degree to the state of complete polarization. This conclusion, which had been derived from reasoning on the hypothesis that a pencil of light, composed of two pencils polarized respectively at angles of + and − 45° with the plane of reflexion, was equivalent to a pencil of common light, is confirmed in this paper by experiment, made with common light itself, reflected from different parts of the atmosphere, and from which the uniaxal or biaxal systems of rings were obtained. On placing such a system between light partially polarized in an opposite plane, the author found that the rings disappeared, the direct system being seen on one side of the plane of disappearance, and the complementary system on the other side. In this experiment the polarization of the light in one plane was compensated by the polarization of the same light in the opposite plane; and, consequently, both the pencils, which had undergone the two successive polarizing actions, had received the same degree of polarization in opposite planes; and in virtue of these two equal and opposite polarizations, the light at the point of compensation, where the system of rings disappeared, had been restored from partially polarized to common light; and the light on each side of this point of compensation was in opposite states of partial polarization.

In order to give a distinct view of the nature of this experiment, the author details the phenomena observed at particular angles of incidence on glass. From the results at an angle of incidence of 24°, the ray suffering one refraction at 80°, and a second reflexion

at $83\frac{1}{2}°$, he concludes that the compensation which takes place is produced neither by an equality of oppositely polarized rays, nor by a proportional admixture of common light, but by equal and opposite physical states of the whole pencil, whether reflected or refracted.

The remarkable phenomena produced at an angle of incidence on glass of 82° 44′ (at which angle $\cos (i + i') = \cos^2 (i + i')$), led the author to the construction of what he terms *the compensating rhomb*, consisting of a well annealed rhomb of glass, or any other uncrystallized substance, having the angles of its base 130° 25′ and 46° 35′ respectively, when the index of refraction is 1·525. When a ray of light is incident upon the first surface at an angle of 82° 44′, exactly one-half of it is reflected; and the other half, after refraction, is reflected at the second surface, and emerges perpendicularly to the adjacent surface, without suffering refraction; each portion having, in the first instance, the same quantity of polarized light. The second portion is found, on examination, to be in the state of common light, although the ray at the second incidence consisted of more than one-half of polarized light. Hence if the pencil, previously to reflexion at the second surface, consist of 145 rays of polarized light, and 188 of common light, the effect of a single reflexion must be to depolarize polarized light, and to produce no change whatever upon common light, a property of a reflecting surface never yet recognized, and incompatible with all our present knowledge on the subject of the polarization of light.

The author then describes an instrument which he has invented for the purpose of accurately measuring the degrees of polarization, and which he therefore terms a *Polarimeter*. It consists of two parts; one of which is intended to produce a ray of compensation having a physical character susceptible of numerical expression, and the other to produce polarized bands, or rectilineal isochromatic lines, the extinction of which indicates that the compensation is effected. The construction and mode of operation of this instrument are, by the aid of figures, described and explained.

The following is the general law established by these researches; namely, that the compensations of polarized light are produced by equal and opposite rotations of the planes of polarization. Thus, when a ray of common light is incident, at any angle, upon the polished surface of a transparent body, the whole of the reflected pencil suffers a physical change, bringing it more or less into a state of complete polarization, in virtue of which change its planes of polarization are more or less turned into the plane of reflexion; while the whole of the refracted pencil has suffered a similar, but opposite change, in virtue of which its planes of polarization are turned more or less into a plane perpendicular to the plane of reflexion.

The author then enters into a theoretical investigation of the subject, and concludes by pointing out a few of the numerous applications of his theory.

2. Continuation of the paper of which the reading commenced

at the last Meeting, and entitled, "Researches tending to prove the Non-vascularity of certain Animal Tissues, and to demonstrate the peculiar uniform mode of their Organization and Nutrition." By Joseph Toynbee, Esq. Communicated by Sir Benjamin C. Brodie, Bart., F.R.S.

In the introduction to this paper, the author first speaks of the process of nutrition in the animal tissues which are pervaded by ramifications of blood-vessels; pointing out the circumstance, that even in them there is a considerable extent of tissue which is nourished without being in contact with blood-vessels. The knowledge of this fact leads us to the study of the process of nutrition in the non-vascular tissues; which tissues he divides into the three following classes; namely, first, those comprehending articular cartilage, and the cartilage of the different classes of fibro-cartilage. Under the second head he comprises the cornea, the crystalline lens, and the vitreous humour; and, under the third, he arranges the epidermoid appendages; viz. the epithelium, the epidermis, nails and claws, hoofs, hair and bristles, feathers, horn and teeth.

The author then proceeds to show that the due action of the organs, into the composition of which these tissues enter, is incompatible with their vascularity. In proof of the non-existence of blood-vessels in these tissues, he states that he has demonstrated, by means of injections, that the arteries, which previous anatomists had supposed to penetrate into their substance, either as serous vessels, or as red-blood vessels too minute for injection, actually terminate in veins before reaching them; he also shows that around these non-vascular tissues there are numerous vascular convolutions, large dilatations and intricate plexuses of blood-vessels, the object of which he believes to be to arrest the progress of the blood, and to allow a large quantity of it to circulate slowly around these tissues, so that its nutrient liquor may penetrate into and be diffused through them. The author states that all the non-vascular tissues have an analogous structure, and that they are composed of corpuscles, to which he is induced to ascribe the performance of the very important functions in the process of their nutrition, of circulating throughout, and perhaps of changing the nature of the nutrient fluid which is brought by blood-vessels to their circumference. The author then brings forward facts in proof of the active and vital properties of these corpuscles, and concludes his Introduction by stating, that it appears to him, that the only difference in the mode of nutrition between the vascular and the non-vascular tissues is, that in the former, the fluid which nourishes them is derived from the blood that circulates throughout the capillaries contained in their substance; whilst, in the latter, the nutrient fluid exudes into them from the large and dilated vessels that are distributed around them: and that in both classes, the particles of which the tissues are composed derive from this fluid the elements which nourish them.

The author then enters on an examination of the structure and mode of nutrition of the several tissues of each of these three classes.

In considering the first class, he commences with articular cartilage, which he describes at great length in the various stages of its developement, and at the different periods of life. He gives in detail the account of numerous dissections of the ovum and fœtus illustrating the first stage, during which he shows that no blood-vessels enter into the substance of any of the textures composing a joint; but that the changes its component parts undergo, are effected by the nutrient fluid from the large blood-vessels, by which, at this stage, each articulation is surrounded. In the second stage of the developement of articular cartilage, the author shows, by numerous dissections, the process by which the blood-vessels are extended into the substance of the epiphysal cartilage, and converge towards the attached surface of articular cartilage, and how, at the same time, blood-vessels are equally prolonged over a certain portion of its free surface. He shows that none of these blood-vessels enter the substance of the articular cartilage, and he points out that in them the arteries become continuous with the veins; first, by their terminating in a single vessel, from which the veins arise; secondly, by their forming large dilatations from which the veins originate; and, lastly, they become directly continuous with the veins in the formation of loops of various characters. In the third stage, that which is exhibited in adult life, the epiphysal cartilage is converted into osseous cancelli. These contain large blood-vessels, which are separated from the articular cartilage by a layer of bone composed of corpuscles, and the author believes that the principal source of nutrition to this tissue is the nutrient fluid which exudes into it from these vessels, by passing through the articular lamella just noticed. The free surface of adult articular cartilage is nourished by vessels which pass to a slight extent over it. The author points out the presence of fine tubes which pervade the attached portion of adult articular cartilage, to which he ascribes the function of transmitting through its substance the nutritive fluid derived from the vessels of the cancelli. He also advances the opinion that the articular cartilage becomes thinner during the whole of life, by being gradually converted into bone.

Fibro-cartilage constitutes the second tissue of the first class. The author first enters upon an examination of its structure; and in order to arrive at some definite conclusions on this subject, whereon anatomists of all ages have so much differed, he made numerous dissections of fibro-cartilages in the different classes of animals at various periods of their developement, the results of which he details. He arrives at the conclusion that this tissue is composed of cartilaginous corpuscles and of fibres; the latter preponderating in adult life, the former in infancy; and that during life the corpuscles are gradually converted into fibres. He enters at length into the question of the vascularity of these cartilages; and from a careful study of many injected specimens of man and animals at various periods of their developement, the particular results of which he relates, he believes that blood-vessels are contained only in their fibrous portion, and have the function of nourishing that which is cartila-

ginous, and which, on account of its being subject to compression and concussion, does not contain any.

Among the second class of extra-vascular tissues, the cornea is first treated of; and its structure is described as being very lax, and as containing corpuscles only in a small quantity. The opinions in favour of its vascularity are combated; and it is shown that the blood-vessels which converge to its attached margin, and which are the principal source of the fluid that nourishes it, are large and numerous, and that at the circumference of this tissue the arteries, without any diminution of their calibre, return in their course, and become continuous with the veins. A second set of vessels, devoted to the nutrition of the cornea, is also described; they extend to a short distance over the surface of the tissue, but do not penetrate into its substance.

The crystalline lens is described as being composed of corpuscles, of which the radiating fibres are constituted. The arteria centralis retinæ is described as ramifying over the posterior surface of the capsule, where it forms large branches; these pass round the circumference of the lens, and reach its anterior surface, at the periphery of which they become straight: the arteries terminate in loops frequently dilated, and become continuous with the veins. With respect to the vascularity of the vitreous humour, the author states that although many anatomists have, in general terms, represented the arteria centralis retinæ as giving off, in its course through this organ, minute branches into its substance, still those who have paid especial attention to the subject, have not been able to find such vessels. He believes that the nutrition of this structure is accomplished by the fluid brought to its surface by the ciliary processes of the choroid, which fluid is diffused with facility through its entire substance by means of the corpuscles of which its membrane is composed, assisted by the semifluid character of the humour.

The third class of extra-vascular tissues comprehends the epidermoid appendages. The author describes them all as composed of corpuscles, which are round and soft where they are in contact with the vascular chorion, compressed and flattened where they are farther removed from it. He points out, in the substance of the hoof of the Horse, the existence of fine canals, which he supposes to conduct fluid through its mass; and he states that the perspiratory ducts of the human subject possess a structure analogous to the spiral vessels of plants. The author describes each of the tissues of this class at length, and shows that the various modifications presented by the vascular system with which each is in contact, have the sole object of enabling a large quantity of blood to approach and circulate slowly around them. He also points out, in connexion with this subject, the remarkable vital properties which are possessed by these non-vascular tissues.

In concluding this paper, the author states that his object has been to establish as a law in animal physiology, that tissues are capable of being nourished, and of increasing in size, without the presence of blood-vessels within their substance. He shows the analogy

which is presented between the extra-vascular animal and the extra-vascular vegetable tissues. He expresses a hope that the application to surgery of the above law, with reference to the prolongation of blood-vessels into the extra-vascular tissues during disease, and to pathology in the investigation of the nature of morbid structures, particularly of those classes which contain no blood-vessels, will be not devoid of interest, and will be productive of some advantage.

The Society then adjourned over the Whitsun recess, to meet again on the 10th of June next.

June 10, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The Most Noble the Marquis of Westminster, Sir Thomas Baring, Bart., Edward Blore, Esq., Samuel Seaward, Esq. and Alfred Smee, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Magnetic-term Observations made at Milan, on the 21st and 22nd of April, 1841." Communicated by Professor Carlini, For. Memb. R.S.

2. "Register of Tidal Observations made at Prince of Wales's Island, in July, August and September, 1840."

3. "Register of Tidal Observations made at Singapore in July, August and September, 1840."

These two papers were presented by the Directors of the East India Company, and communicated by P. M. Roget, M.D., Sec. R.S.

4. "On the Anatomy and Physiology of certain structures in the Orbit, not previously described." By J. M. Ferrall, Esq., M.R.I.A. Communicated by Sir Benjamin C. Brodie, Bart., F.R.S.

The author describes a distinct fibrous tunic, which he terms the *tunica vaginalis oculi*, continuous with the tarsal cartilages and ligaments in front, and extending backwards to the bottom, or apex of the orbit; thus completely insulating the globe of the eye, and keeping it apart from the muscles which move it. The eye-ball is connected with this fibrous investment by a cellular tissue, so lax and delicate as to permit an easy and gliding motion between them. The use which the author assigns to this tunic is that of protecting the eye-ball from the pressure of its muscles while they are in action. This tunic is perforated at its circumference, and a few lines posterior to its anterior margin, by six openings, through which the tendons of the muscles emerge in passing to their insertions, and over which, as over pullies, they play in their course. A consequence of this structure is that the recti muscles become capable of giving rotatory motions to the eye without occasioning its retraction within the orbit, and without exerting injurious pressure on that organ. In those animals which are provided with a proper retractor muscle,

the recti muscles are, by means of this peculiar mechanism, enabled to act as antagonists to that muscle.

5. "An account of some recent improvements in Photography." By H. F. Talbot, Esq. F.R.S.

The author had originally intended, in giving an account of his recent experiments in photography, to have entered into numerous details with respect to the phenomena observed; but finding that to follow out this plan would occupy a considerable time, he has thought that it would be best to put the Society, in the first place, in possession of the principal facts, and by so doing perhaps invite new observers into the field during the present favourable season for making experiments. He has, therefore, confined himself at present to a description of the improved photographic method, to which he has given the name of *Calotype*, and reserves for another occasion all remarks on the theory of the process.

The following is the method of obtaining the Calotype pictures.

Preparation of the Paper.—Take a sheet of the best writing paper, having a smooth surface, and a close and even texture.

The watermark, if any, should be cut off, lest it should injure the appearance of the picture. Dissolve 100 grains of crystallized nitrate of silver in six ounces of distilled water. Wash the paper with this solution, with a soft brush, on one side, and put a mark on that side whereby to know it again. Dry the paper cautiously at a distant fire, or else let it dry spontaneously in a dark room. When dry, or nearly so, dip it into a solution of iodide of potassium containing 500 grains of that salt dissolved in one pint of water, and let it stay two or three minutes in this solution. Then dip it into a vessel of water, dry it lightly with blotting-paper, and finish drying it at a fire, which will not injure it even if held pretty near: or else it may be left to dry spontaneously.

All this is best done in the evening by candlelight. The paper so far prepared the author calls *iodized paper*, because it has a uniform pale yellow coating of iodide of silver. It is scarcely sensitive to light, but, nevertheless, it ought to be kept in a portfolio or a drawer, until wanted for use. It may be kept for any length of time without spoiling or undergoing any change, if protected from the light. This is the first part of the preparation of Calotype paper, and may be performed at any time. The remaining part is best deferred until shortly before the paper is wanted for use. When that time is arrived, take a sheet of the *iodized paper* and wash it with a liquid prepared in the following manner:—

Dissolve 100 grains of crystallized nitrate of silver in two ounces of distilled water; add to this solution one-sixth of its volume of strong acetic acid. Let this mixture be called A.

Make a saturated solution of crystallized gallic acid in cold distilled water. The quantity dissolved is very small. Call this solution B.

When a sheet of paper is wanted for use, mix together the liquids A and B in equal volumes, but only mix a small quantity of them at a time, because the mixture does not keep long without spoiling. I shall call this mixture the *Gallo-nitrate of silver*.

Then take a sheet of *iodized paper* and wash it over with this *gallo-nitrate of silver*, with a soft brush, taking care to wash it on the side which has been previously marked. This operation should be performed by candlelight. Let the paper rest half a minute, and then dip it into water. Then dry it lightly with blotting-paper, and finally dry it cautiously at a fire, holding it at a considerable distance therefrom. When dry, the paper is fit for use. The author has named the paper thus prepared *Calotype paper*, on account of its great utility in obtaining the pictures of objects with the camera obscura. If this paper be kept in a press it will often retain its qualities in perfection for three months or more, being ready for use at any moment; but this is not uniformly the case, and the author therefore recommends that it should be used in a few hours after it has been prepared. If it is used immediately, the last drying may be dispensed with, and the paper may be used moist. Instead of employing a solution of crystallized gallic acid for the liquid B, the *tincture of galls* diluted with water may be used, but he does not think the results are altogether so satisfactory.

Use of the Paper.—The *Calotype paper* is sensitive to light in an extraordinary degree, which transcends a hundred times or more that of any kind of photographic paper hitherto described. This may be made manifest by the following experiment:—Take a piece of this paper, and having covered half of it, expose the other half to daylight for the space of *one second* in dark cloudy weather in winter. This brief moment suffices to produce a strong impression upon the paper. But the impression is latent and invisible, and its existence would not be suspected by any one who was not forewarned of it by previous experiments.

The method of causing the impression to become visible is extremely simple. It consists in washing the paper once more with the *gallo-nitrate of silver*, prepared in the way before described, and then warming it gently before the fire. In a few seconds the part of the paper upon which the light has acted begins to darken, and finally grows entirely black, while the other part of the paper retains its whiteness. Even a weaker impression than this may be *brought out* by repeating the wash of gallo-nitrate of silver, and again warming the paper. On the other hand, a stronger impression does not require the warming of the paper, for a wash of the gallo-nitrate suffices to make it visible, without heat, in the course of a minute or two.

A very remarkable proof of the sensitiveness of the Calotype paper is afforded by the fact stated by the author, that it will take an impression from simple moonlight, not concentrated by a lens. If a leaf is laid upon a sheet of the paper, an image of it may be obtained in this way in from a quarter to half an hour.

This paper being possessed of so high a degree of sensitiveness, is therefore well suited to receive images in the camera obscura. If the aperture of the object-lens is one inch, and the focal length fifteen inches, the author finds that *one minute* is amply sufficient in summer to impress a strong image upon the paper of any building

upon which the sun is shining. When the aperture amounts to one-third of the focal length, and the object is very white, as a plaster bust, &c., it appears to him that *one second* is sufficient to obtain a pretty good image of it.

The images thus received upon the Calotype paper are for the most part invisible impressions. They may be made visible by the process already related, namely, by washing them with the gallo-nitrate of silver, and then warming the paper. When the paper is quite blank, as is generally the case, it is a highly curious and beautiful phenomenon to see the spontaneous commencement of the picture, first tracing out the stronger outlines, and then gradually filling up all the numerous and complicated details. The artist should watch the picture as it developes itself, and when in his judgment it has attained the greatest degree of strength and clearness, he should stop further progress by washing it with the fixing liquid.

The fixing process.—To fix the picture, it should be first washed with water, then lightly dried with blotting paper, and then washed with a solution of *bromide of potassium*, containing 100 grains of that salt dissolved in eight or ten ounces of water. After a minute or two it should be again dipped in water and then finally dried. The picture is in this manner very strongly fixed, and with this great advantage, that it remains transparent, and that, therefore, there is no difficulty in obtaining a copy from it. The Calotype picture is a *negative* one, in which the lights of nature are represented by shades; but the copies are *positive*, having the lights conformable to nature. They also represent the objects in their natural position with respect to right and left. The copies may be made upon Calotype paper in a very short time, the invisible impressions being *brought out* in the way already described. But the author prefers to make the copies upon photographic paper prepared in the way which he originally described in a memoir read to the Royal Society in February 1839, and which is made by washing the best writing paper, *first* with a weak solution of common salt, and *next* with a solution of nitrate of silver. Although it takes a much longer time to obtain a copy upon this paper, yet when obtained, the tints appear more harmonious and pleasing to the eye; it requires in general from 3 minutes to 30 minutes of sunshine, according to circumstances, to obtain a good copy on this sort of photographic paper. The copy should be washed and dried, and the fixing process (which may be deferred to a subsequent day) is the same as that already mentioned. The copies are made by placing the picture upon the photographic paper, with a board below and a sheet of glass above, and pressing the papers into close contact by means of screws or otherwise.

After a Calotype picture has furnished several copies, it sometimes grows faint, and no more good copies can then be made from it. But these pictures possess the beautiful and extraordinary property of being susceptible of revival. In order to revive them and restore their original appearance, it is only necessary to wash them

again by candlelight with gallo-nitrate of silver, and warm them: this causes all the shades of the picture to darken greatly, while the white parts remain unaffected. The shaded parts of the paper thus acquire an opacity which gives a renewed spirit and life to the copies, of which a second series may now be taken, extending often to a very considerable number. In reviving the picture it sometimes happens that various details make their appearance which had not before been seen, having been latent all the time, yet nevertheless not destroyed by their long exposure to sunshine.

The author terminates these observations by stating a few experiments calculated to render the mode of action of the sensitive paper more familiar.

1. Wash a piece of the *iodized paper* with the gallo-nitrate; expose it to daylight for a second or two, and then withdraw it. The paper will soon begin to darken spontaneously, and will grow quite black.

2. The same as before, but let the paper be warmed. The blackening will be more rapid in consequence of the warmth.

3. Put a large drop of the gallo-nitrate on one part of the paper and moisten another part of it more sparingly, then leave it exposed to a very faint daylight; it will be found that the lesser quantity produces the greater effect in darkening the paper; and in general, it will be seen that the most rapid darkening takes place at the moment when the paper becomes nearly dry; also, if only a portion of the paper is moistened, it will be observed that the edges or boundaries of the moistened part are more acted on by light than any other part of the surface.

4. If the paper, after being moistened with the gallo-nitrate, is washed with water and dried, a slight exposure to daylight no longer suffices to produce so much discoloration; indeed it often produces none at all. But by subsequently washing it again with the gallo-nitrate and warming it, the same degree of discoloration is developed as in the other case (experiments 1 and 2). The dry paper appears, therefore, to be equal, or superior in sensitiveness to the moist; only with this difference, that it receives a *virtual* instead of an *actual* impression from the light, which it requires a subsequent process to develope.

5. " New mode of preparation of the Daguerréotype plates, by which portraits can be taken in the short space of time of from five to fifteen seconds, according to the power of light, discovered by A. Claudet in the beginning of May 1841." Communicated by the Marquis of Northampton, Pres. R.S.

" My improvement," says the author, " consists in using for the preparation of the plates, a combination of chlorine with iodine, in the state of chloride of iodine. I follow the preparation recommended by Daguerre. After having put the plate in the iodine box for a short time, and before it has acquired any appearance of yellow colour, I take it out, and pass it for about two seconds over the opening of a bottle containing chloride of iodine; and immediately I put it again in the iodine box, where it acquires very soon the yellow

colour, which shows that the plate is ready to be placed into the camera obscura. I have substituted to the chloride of iodine, chloride of bromine, and have found nearly the same result; but I prefer chloride of iodine as producing a better effect; and besides, on account of the noxious smell of bromine.

"The result of my preparation is such, that I have operated in ten seconds with the same apparatus, which, without any chlorine, required four or five minutes; when using only the original preparation of Daguerre, I have obtained an image of clouds in *four seconds.*"

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1841. No. 49.

June 17, 1841.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The Right Honourable Lord Crewe, James Alderson, M.D., and Edward James Seymour, M.D., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Experiments on the electric conditions of the Rocks and Metalliferous Veins (Lodes) of Longclose and Rosewall Hill Mines in Cornwall." By William Jory Henwood, Esq., F.R.S., &c., Secretary of the Royal Geological Society of Cornwall.

The experiments, of which the results are given in this paper, were undertaken with the view of determining whether it was in consequence of the imperfections of the galvanometers, or other apparatus, employed, that Mr. R. W. Fox, and other experimenters, had been unable to detect the presence of electricity in the tin veins of Cornwall. The mode of experimenting was in principle the same as that pursued by Mr. Fox, namely, that of placing plates of metal in contact with the points to be examined, carrying wires from the one to the other, and interposing a galvanometer in the circuit. The plates employed were of sheet-copper and sheet-zinc, and they were about six inches long, and three inches and a half wide. The wires were of copper, one twentieth of an inch in diameter, and the same that had been used by Mr. Fox.

The tabular results of these experiments show that both the granite and the tin vein at *Rosewall Hill* mine, and also the greenstone and the copper vein in that of Longclose, present unequivocal traces of electric currents, whether different parts of the same veins or various portions of the same rocks were examined.

It also appears, from these experiments, that the nature and positions of the small metallic plates employed materially affect, not only the intensity, but in some cases also the directions of the currents; and also that there is a considerable difference in the results when the same plates of metal are placed on different ingredients in the veins, even though these may be in immediate contact with each other.

2. "Researches in the Theory of Machines." By the Rev. H. Moseley, M.A., F.R.S., Professor of Natural Philosophy and Astronomy in King's College, London.

Of the various names, such as "useful effect," "dynamical effect," "efficiency," "work done," "labouring force," "work," which have been given to that operation of force in machinery which consists in the union of a continued pressure with a continued motion, the author gives the preference to the term *work*, as being that which conveys, under its most intelligible form, this idea of the operation of force, and as being the literal translation of the word "travail," which among French writers on mechanics has taken the place of every other.

The single unit, in terms of which this operation of force is with us measured, viz. the work of overcoming a pressure of one pound through one foot, he considers to be distinguished sufficiently, and expressed concisely enough, by the term *unit of work*, rejecting as unnecessary, and as less likely to pass into general use, the terms "dynamical unit," and "dynam," which it has been proposed to apply to it.

Having thus defined the terms *work* and *unit of work*, and paid a tribute of respect to the valuable labours of M. Poncelet in the theory of machines, and expressed admiration of the skill with which he has applied to it the well-known principle of *vis viva* under a new and more general form, the author proceeds to remark, that the interpretation which M. Poncelet has given to that function of the velocity of a moving body which is taken as the measure of its vis viva, associates with it the definitive idea of a force opposed to all change in the state of the bodies' rest or motion, and known as its "*vis inertiæ*," "*vis insita*," &c. The author conceives that the introduction of the definitive idea of such a force into questions of elementary and practical mechanics is liable to many and grave objections; and he proposes a new interpretation of it, viz. "that one half of this function represents the number of units of work accumulated in the moving body, and which it is capable of reproducing upon any resistance opposed to its progress." This interpretation he establishes by mechanical considerations of an elementary kind. Taking, then, this new interpretation of the function representing one half the vis viva, and dividing the parts of a machine into those which receive the operation of the moving power (the moving points) and those which apply it (the working points), he presents the principle of vis viva in its application to machines under the following form:—"The number of units of work done by the moving power upon the moving points of the machine is equal to the number yielded at the working points, *plus* the number expended upon the prejudicial resistances, *plus* the number accumulated in the various parts of the machine which are in motion." So that the whole number of units of work done by the moving power, or upon the moving points, is expended, partly in that work done at the working points, whence results immediately the useful product of the machine, and partly upon the prejudicial resistances of friction, &c. opposed to the motion of the machine in

its transmission from the moving to the working points; and all the rest is accumulated or treasured up in the moving parts of the machine, and is reproducible whenever the work of the moving power from exceeding shall fall short of that which must be expended upon the useful and the prejudicial resistances to carry on the machine.

He then proceeds to observe, that in every machine there thus exists a direct relation between these four elements,—the work done upon the moving points, that expended at the working points, that expended on the prejudicial resistances, and that accumulated in the moving elements. This relation, which is always the same for the same machine, and different for different machines, he proposes to call, in respect to each particular machine, its *modulus*; and he states the principal object of this paper (and of another which he proposes subsequently to submit to the Society) to be, first, the general determination of the modulus of a simple machine; secondly, that of a compound machine, from a knowledge of the moduli of its component elements; and, thirdly, the application of these general methods of determination to some of the principal elements of machinery, and to the machines which are in common use.

The author then states, that the velocities of the different parts, or elements of every machine are connected with one another by certain invariable relations, capable of being expressed by mathematical formulæ; so that, though these relations are different for different machines, they are the same for the same machine. Thus it becomes possible to express the velocity of any element of a machine, at any period of its motion, in terms of the corresponding velocity of any other element. Whence it results that the whole vis viva of the machine may at any time be expressed in terms of the corresponding velocity of its moving point (that is, the point where the moving power is applied to it), and made to present itself under the form $V^2 \Sigma \omega \lambda^2$, where V represents the velocity of the moving point of the machine, ω the weight of any element, and λ a factor determining the velocity of that element in terms of the velocity V of the moving point. Substituting this expression for the vis viva or accumulated work in the modulus and solving in respect to V, an expression is obtained, whence it becomes apparent that the variation of the velocity V of the moving point, produced by any given irregularity in the work done upon the moving or working points, will be less, as the factor $\Sigma \omega \lambda^2$ is greater. This factor, determinable in every machine, and upon which the uniformity of its action under given variations of the power which impels it depends, he proposes to introduce into the general discussion of the theory of machines as the *coefficient of equable motion.*

He then proceeds to investigate general methods for the determination of the modulus of a machine, deducing them from those general relations which are established by the principles of statics, between the pressures applied to the machine, in its state bordering upon motion.

That he may escape that complication of formulæ which results from the introduction of friction, by the ordinary methods, into the

consideration of questions of equilibrium, the author calls to his aid a principle, first published by himself in a paper on the 'Theory of the Equilibrium of Bodies in contact,' printed in the fifth volume of the Cambridge Philosophical Transactions, viz. "that when the surfaces of two bodies are in contact under any given pressures, and are in the state bordering upon motion, on those surfaces, then the common direction of the mutual resistances of the surfaces is inclined to their normal at the point of contact at a certain angle, given in terms of the friction of the surfaces by the condition that its tangent is equal to the coefficient of friction." This angle the author has called "*the limiting angle of resistance*:" it has since been used by other writers under the designation of the "*slipping angle*."

He next proceeds to determine the modulus of a simple machine, moveable about a cylindrical axis of given dimensions, and acted upon by any number of pressures in the same plane. He applies the principle last stated to determine the general conditions of the equilibrium of these pressures, in the state bordering upon motion by the preponderance of one of them; and, solving the resulting equation in respect to that one pressure by the aid of Lagrange's theorem, he deduces immediately the modulus from this solution by principles before laid down. The modulus, thus determined, he then verifies by an independent discussion of that particular case in which three pressures only are applied to the machine, one of which has its direction through the centre of the axis.

This solution he next considers more particularly with reference to a machine moveable about a fixed axis under one moving and one working pressure (their directions being any whatever) and its own weight; which last is supposed to act through the centre of the axis. He shows that it is a general condition of the greatest economy in the working of such a machine, that the moving and working pressures should have their directions, one of them upwards, and the other downwards, and that both should therefore be applied on the same side of the axis of the machine. He moreover shows that if the direction of one of these pressures be given, there is then a certain perpendicular distance of the other from the centre of the axis, and a certain inclination of its direction to the vertical, at which perpendicular distance, and which inclination, this pressure being applied, the machine will yield a greater amount of work, by the expenditure of a given amount of power, than it will yield under any other circumstances of its application: so that this particular distance and inclination are those whence results the most economical working of the machine.

Professor Moseley then commences his application of these general principles to elementary machines with the pulley. He establishes the modulus of the pulley under any given inclination of the parts of the cord passing over it, taking into account the friction of the axis, the weight of the pulley and the rigidity of the cord, and adopting, with respect to the last element, the experiments of Coulomb. This general form of the modulus of the pulley he applies, first, to the case in which both strings are parallel, and inclined to the vertical

at any angle; secondly, to the case in which they are equally inclined on either side of the vertical; thirdly, to the case in which one is horizontal and the other vertical; and, fourthly, to that in which both are horizontal. He concludes his paper by a deduction from this last case of the modulus of a system of any number of pulleys or sheaves, sustaining among them the weight of any given length of rope horizontally.

3. "On the Nervous Ganglia of the Uterus." By Robert Lee, M.D., F.R.S.

The author, in a paper which was read to the Royal Society on the 12th of December, 1839, had described four great plexuses under the peritoneum of the gravid uterus, having an extensive connexion with the hypogastric and spermatic nerves. From their form, colour, general distribution, and resemblance to ganglionic plexuses of nerves, and from their branches actually coalescing with those of the hypogastric and spermatic nerves, he was induced to believe, on first discovering them, that they were ganglionic nervous plexuses, and that they constituted the special nervous system of the uterus. He states in the present paper, that subsequent dissections of the unimpregnated uterus, and of the gravid uterus in the third, fourth, sixth, seventh, and ninth months of pregnancy, have enabled him not only to confirm the accuracy of his former observations, but also to discover the important fact, that there are many large ganglia on the uterine nerves, and on those of the vagina and bladder, which enlarge with the coats, blood-vessels, nerves, and absorbents of the uterus during pregnancy, and which return, after parturition, to their original condition before conception took place. The author next proceeds to describe the two great ganglia situated on the sides of the neck of the uterus, in which the hypogastric and several of the sacral nerves terminate, and which he calls the *hypogastric*, or *utero-cervical ganglia*. In the unimpregnated state, they are of an irregular, triangular, or oblong shape, about half an inch in the long diameter, and always consist of grey and white matter, like other ganglia. They are covered by the trunks of the vaginal and vesical arteries and veins; and each ganglion has an artery of considerable size, which enters it near the centre and divides into branches, accompanying the nerves given off from its anterior and inferior borders. From the inner and posterior surface of each of these ganglia, nerves pass off, which anastomose with the hæmorrhoidal nerves, and ramify on the sides of the vagina, and between the vagina and rectum. From the inferior border of each hypogastric ganglion several fasciculi of nerves are given off, which pass down on the sides of the vagina, and enter some large flat ganglia, midway between the os uteri and ostium vaginæ. From these vaginal ganglia innumerable filaments of nerves, on which small flat ganglia are formed, extend to the sphincter, where they are lost in a white dense membranous expansion. From this great web of ganglia and nerves numerous branches are sent to the sides of the bladder, and enter it around the ureter. All these nerves of the vagina are accompanied with arte-

ries; and they often form complete rings of nerve around the trunks of the great veins.

The author then describes the nerves which are given off from the anterior margin of each hypogastric ganglion, some of which pass on the outside of the ureter, and others on the inside, and meet in front of the ureter in a ganglion, which he calls the *middle vesical ganglion*. There are other two ganglia, he states, formed on these nerves; one between the uterus and ureter, and the other between the ureter and vagina. These he calls *the internal and external vesical ganglia*. Not only is the ureter inclosed within a great ring of nervous matter, which, he says, resembles the œsophageal ganglia in some of the invertebrata; but the trunks of the uterine artery and vein are likewise encircled by a great collar of nervous matter, between which and the hypogastric ganglion several large and some small branches pass.

The author gives the following description of the vesical ganglia. The internal vesical ganglion, which usually has a flattened or long bulbous shape, is formed entirely upon the nerves which pass from the hypogastric ganglion, and run between the uterus and the ureter. It has an artery which passes through its centre. It first gives off a large branch to the ring of nerve or ganglion which surrounds the uterine blood-vessels; it then sends branches to the anterior part of the cervix uteri, and afterwards a great number of small filaments to the muscular coat of the bladder behind, where it is in contact with the uterus; and it then sends forwards a large branch, which terminates in the middle vesical ganglion. This ganglion sends off a great number of large nerves to the bladder. Some of these accompany the arteries, and can be seen ramifying with them upon the whole of the superior part of the organ, even to the fundus. Filaments of these nerves, scarcely visible to the naked eye, are seen in one of the preparations ramifying upon the bundles of muscular fibres, occasionally forming loops and inclosing them, or passing down between them to the strata of fibres below. Some of the smaller branches of the middle vesical ganglion do not accompany the arteries, but are distributed at once to the parts of the bladder around the ureter.

The external vesical ganglion is formed entirely upon the nerves which proceed from the hypogastric ganglion, and pass on the outside of the ureter. This is a small thin ganglion, the branches of which are sent immediately into the muscular coat of the bladder. It usually sends down a long branch to anastomose with the nerves issuing from one of the vaginal ganglia.

From the inner surface of each hypogastric ganglion numerous small white, soft, nerves pass to the uterus, some of which ramify upon the muscular coat about the cervix, and others spread out under the peritoneum to coalesce with the great ganglia and plexuses situated on the posterior and anterior surfaces of that organ. Large branches also go off from the inner surface of the ganglion to the nerves surrounding the blood-vessels of the uterus, which they accompany in all their ramifications throughout its muscular coat.

This paper is illustrated by two drawings, in which the hypogas-

tric, vaginal, vesical and uterine ganglia are delineated in the fourth month of pregnancy, and also the plexuses of nerves on the anterior surface of the uterus.

From an examination with the microscope of portions of the plexuses under the peritoneum of a gravid uterus in the ninth month, which had long been immersed in rectified spirit, Professor Owen and Mr. Kiernan inferred that they were not nervous plexuses, but bands of elastic tissue, gelatinous tissue, or cellular membrane.

The author concludes his paper with a letter from John Dalrymple, Esq., containing the results of the observations he had made with the microscope on the uterine nerves in the recent state. Filaments of the nerves which surrounded the ureter, and which were situated upon the body of the uterus, were submitted to the microscope. The instrument employed was a very powerful object-glass, whose focus was the eighth of an inch, made by Ross. Mr. Dalrymple found that it was impossible, even with the most careful dissection, to detach any filament of nerve without including a quantity of cellular and elastic tissue; so that although the tubular portion indicating the nerve was distinct, yet it was surrounded by innumerable extremely minute threads coiled and contorted, such as those which constitute the component of elastic tissue, and the ultimate element of cellular membrane. Under slight pressure, however, the tube was plainly discernible, and was found to contain granular matter, not uniformly distributed, but collected in minute masses at intervals. Small blood-vessels were also here and there seen, with blood-discs within them, which served to indicate the difference between the nervous and vascular tubes, and thus to avoid the possibility of error. Being, however, aware that some of the most distinguished foreign microscopical anatomists had differed as to what was the real characteristic of the nerves of the sympathetic system, and feeling, from this discordance of opinion, that there was no absolute test, or at least none which was not open to cavil, Mr. Dalrymple thought of making a comparison of the uterine nerves with those that undeniably belonged to the ganglionic system. He therefore traced some nerves on the surface of the stomach up to the great ganglion that gave them origin; and he selected some also from the small intestine. These he submitted to the same microscopical power, and under the same circumstances of light, and pressure, and medium. In all of these he observed the tubular part filled with granular matter, and similarly collected in minute masses. He also observed that each tube was surrounded by the minute serpentine threads before described. In fact, so closely did they agree in every particular with the appearances presented by the uterine nerves, that it would have been impossible to distinguish the one from the other.

4. "On the Corpuscles of the Blood." Part III. By Martin Barry, M.D., F.R.SS. L. and E.

After remarking that no clear conception has hitherto existed of the mode in which the floating corpuscles of the blood conduce to nourishment, the author states that he has found every structure he has

examined to arise out of corpuscles having the same appearance as the corpuscles of the blood. The following are the tissues which he has submitted to actual observation, and which have given the above result, namely, the cellular, the nervous, and the muscular; besides cartilage, the coats of blood-vessels, several membranes, the tables and cells of the epithelium, the pigmentum nigrum, the ciliary processes, the crystalline lens itself, and even the spermatozoon and the ovum.

The author then traces the nucleus of the blood-corpuscle into the pus-globule; showing that every stage in the transition presents a definite figure. The formation of the pus-globule out of the nucleus of the blood-corpuscle is referable to the same process, essentially, as that by means of which the germinal spot comes to fill the germinal vesicle in the ovum. This process, which, in a former memoir, he had traced in the corpuscles of the blood, he now shows to be universal, and nowhere more obvious than in the reproduction of the tables of the epithelium. The epithelium-cylinder seems to be constituted, not by coalescence of two objects previously single, as has been supposed, but by division of a previously single object. Certain objects, called by the author *primitive discs*, exhibit an inherent contractile power, both when isolated, and when forming parts of a larger object; an incipient epithelium-cylinder having been observed by him to revolve by this means. Molecular motions are sometimes discernible within corpuscles of the blood. The author has noticed young blood-corpuscles exhibiting motions, comparable to the molecular, and moving through a considerable space; and he has met with the nuclei of blood-corpuscles endowed with cilia, revolving, and performing locomotion. In his first paper on the Corpuscles of the Blood, he described certain instantaneous changes in form which he had observed in blood-corpuscles, and afterwards expressed his belief, that these changes were referable to contiguous cilia, although he had not been able to discern any such cilia. He now states that subsequent observation inclines him to think that these changes in form arise from some inherent power, distinct from the motions occasioned by cilia. The primitive disc, just mentioned, seems to correspond, in some instances, with the "cytoblast" of Schleiden. Thus the very young corpuscle of the blood is a mere disc; but the older corpuscle is a cell. The author minutely describes the mode of origin of the pigmentum nigrum; showing that it arises in a similar manner in the tail of the tadpole, and in the choroid coat of the eye. He had before described the Graafian vesicle as formed by the addition of a covering to the previously-existing ovisac: this covering, he afterwards stated, becomes the corpus luteum. He now confirms these observations, with the addition, that it is the blood-corpuscles entering into the formation of the covering of the ovisac, which give origin to the corpus luteum. The spermatozoon appears to be composed of a few coalesced discs. The fibres of the crystalline lens are not elongated cells, as supposed by Schwann; but coalesced cells, at first arranged in the same manner as beads in a necklace.

The author concludes with the following recapitulation:—1. The nucleus of the corpuscle of the blood admits of being traced into the pus-globule. 2. The various structures arise out of corpuscles having the same appearance, form, and size as corpuscles of the blood. 3. The corpuscles having this appearance, and giving origin to structures, are propagated by division of their nuclei. 4. The corpuscles of the blood, also, are propagated by division of their nuclei. 5. The minuteness of the young blood-corpuscles is sometimes extreme; and they are to be found in parts usually considered as not being permeable by red blood.

In a postscript, the author adds, that blood found in the heart immediately after death by bleeding, presents incessant alterations in the position of its corpuscles. Among these, when a single corpuscle is examined very attentively, it is seen to change its form; and the author is disposed to think it is this change of form that produces the alterations in position. The changes in form are slight, compared with those previously described by him as observed in blood elsewhere, and are not seen without close attention. The motions resemble those called molecular; and in the minutest corpuscles, which are mere points, nothing besides molecular motion can be discerned. It may be a question, the author thinks, whether molecular motion differs in its nature from the motion of the larger corpuscles just referred to. The division of the blood-corpuscles into corpuscles of minuter size, though apparent in blood from either side of the heart, has seemed more general in that from the left side; which, it is suggested, is perhaps deserving of notice in connexion with the subject of respiration.

5. "A new Theory of Physics, with its application to important phenomena hitherto considered as ultimate facts." By Thomas Exley, Esq., A.M.

The theory of the author is founded on the two following propositions, namely, that

1. Every atom of matter consists of an immense sphere of force, varying inversely as the square of the distance from the centre; this force being attractive at all distances, except in a small concentric sphere, in which it is repulsive.

2. Atoms differ from each other in their absolute forces, or in the extent of their spheres of repulsion, or in both these respects.

The author assumes that there are four classes of atoms, the *tenacious*, the *electric*, the *ethereal*, and the *aromatic*. The existence of the last-named class of atoms he infers from the phenomena of vegetation, the miasmata of marshes, the aroma of plants, various noxious effluvia, the disinfecting property of some bodies, and facts relating to animalcules, and their ova, &c. He regards the two propositions which constitute the great principles of his theory, as presenting, at once, a complete explication of the general attributes of matter and body, with the Newtonian laws of motion, not otherwise theoretically explicable.

After pursuing at some length his theoretical speculations, founded

of the above-mentioned propositions, the author concludes his paper with the following sentence:—

"The several partial theories of philosophers, so far as concerns the leading facts on which they are based, are contained in the simple principles here developed: thus, the theory of universal gravity is here carried out to its ultimatum; Newton and Boscovich's theories of alternate attractions and repulsions are derived from facts which depend on the alternate atmospheres and neutral spaces of gaseous atoms; Sir Humphry Davy's theory of electrical energies, Dr. Dalton's atomic theory, and the theory of the diffusion of gases, Dr. Black's theory of latent heat, Gay-Lussac's theory of volumes, Newton's theory of light, or the theory of the emission of light, the undulatory theory, and very many others are here united in the most simple principles, which are, therefore, strongly recommended to the notice of philosophers."

4. "On the Organs of Reproduction and on the Development of the Myriapoda." By George Newport, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author commences his paper by stating that great interest attaches to the study of the Myriapoda, from the already known fact that their mode of development, by an increase in the number of segments, is directly the reverse of that of true insects in which the development of the perfect individual is accompanied by an apparent diminution in the number of these parts. He remarks, that although the development of the Myriapoda has already been examined by several eminent naturalists, such as Degeer, Savi, Gervais, and Waga, some of the most important facts relating to it have, nevertheless, escaped their notice, and he proposes, therefore, to lay before the Society the result of his own investigations on this subject, and also his examinations of the organs of reproduction.

The paper is divided into four sections. In the first, the author describes the organs of reproduction, and shows that the parts described by Treviranus, both in the male and female Julus, are only the efferential ducts in the male, and the oviduct in the female; that in the former there are developed, from the sides of the efferential ducts, a large number of sacs, the structure of which he describes, and states his opinion that these are the proper secretory organs in the male, but remarks that he has not been able to follow out the organs to their fullest extent. In the female, he shows that the oviduct described by Treviranus is covered by an immense number of ovisacs, each secreting only a single ovum; that many hundreds of these exist around the duct, a large proportion of which never reach maturity, being retarded in their growth by the development of others immediately around them; and that the ova, when matured, are passed from the ovisacs into the duct, and are then all deposited at one time. He adverts especially to the remarkable condition of the female oviduct being a single organ, throughout the greater part of its extent, but having a double outlet; and shows its analogy in the internal portion of the organs to those of some in-

sects, and in its double outlet to the Crustacea and Arachnida. He also institutes a comparison between the structure of the male and female organs in this Myriapod, which, from their simplicity, admirably illustrate the uniformity of origin of these structures; more especially the analogy between the ovisacs in the female and the cæca in the male, and also their conformity in the absence, in the latter, of separate vesiculæ seminales, and, in the former, of spermatheca.

The second section is occupied by a short account of the structure of the ovum, in which the author observes the germinal vesicle and macula. He notices especially the presence of the yelk in the earliest stages of developement, together with the vesicle and the membranes of the ovum at a later period, as showing in this low form of animal the conformity of structure and laws with those which prevail in the higher forms.

In the third section, the author speaks of the deposition of the ova, and of the habits of the species, as observed in specimens collected and preserved by him for that purpose. These habits he regards as particularly curious. The female excavates for herself a burrow, by digging with her mandibles in the soil, which she has previously moistened with a fluid, supplied, as the author believes, by her immense salivary glands. With this she forms a soft pellet, which she removes from the burrow with her mandibles and anterior legs; and thence, after being brought to the top of the hole, it is passed on to the next pair, and by these on to the next in succession, until it is entirely removed out of the way; after which, she deposits her eggs and closes the burrow with moistened clay. Great difficulty was experienced in preserving the eggs during the observations, from the circumstance that their shell is soft, and dries quickly when exposed to the air. To avoid this, the author had recourse to the plan of inclosing the eggs in a glass tube, filled with clay, and closed with a cork; the eggs being placed in a cell next to the glass.

The fourth section, which constitutes the most important part of the paper, gives the history of the evolution of the embryo. The process is divided by the author into different periods. After a few observations on the earlier changes of the egg, and the proof that they consist in an alteration in the size and appearance of the cells out of which the embryo is formed, he states his having observed that the egg bursts at the end of twenty-five days, by means of a fissure along the dorsal surface, as described by Savi and Waga; and that, in opposition to the remarks of Degeer, the young Julus, as first stated by Savi, is perfectly apodal. The author has also discovered a singular fact, entirely overlooked by all who have attended to the developement of these animals, namely, that the young Julus at this time is still an embryo, and is completely inclosed in a shut sac, which terminates in a distinct *funis* at the extremity of the body, and in the proper *amnion*, or fœtal envelope of the animal. He finds, also, that the funis enters at the posterior penultimate segment of the dorsal surface of the body, and not at the dorsal surface of the thoracic region, as seen by Rathke in the Crustacea. The embryo, he says, is retained in connexion with the shell, between the two halves of it, for seven-

teen days, by means of the funis, which is continuous with a second, or external membrane, *the chorion*, which lines the interior of the shell. He states that the liberation of the embryo from the shell is not effected by any effort of its own, but by the expansive force of the growth of its body. He describes, also, another important fact which had been overlooked by previous observers, relating to the mode and place of origin of the new segment of the body in the Julidæ. The new segments are always produced in a *germinal membrane* immediately before the penultimate segment, which segment, with the anal one, remains permanent throughout the life of the animal. The production of the first set of new segments is commenced even before the animal has burst from the amnion. After leaving the amnion, the young Julus possesses six pair of legs, as stated by Savi and Waga ; but the author remarks, in addition, that, notwithstanding this, it is still inclosed in another tunic, the proper skin of the embryo, beneath which new segments are being formed, and which begins to be detached before the embryo has left the amnion. He suggests whether this may not be the representative of the proper tunic of the germinal vesicle. After minutely describing the embryo, and showing that its body is still formed of cells, he states that four pairs of new legs are forming beneath this tunic, and that, on the twenty-sixth day, the young animal throws off this covering, and the legs are developed, and also the six new segments, to a further extent. The animal then takes food, the segments become developed to the same extent as the original ones, until the forty-seventh day, when it again changes its skin, new segments are again produced, and new legs to those segments last formed. In this way it passes through several changes, developing first segments and then legs.

One remarkable circumstance stated is, that the production of segments is *sextuple* in the Julidæ; but this does not hold in other genera, in some of which it is *quadruple*, and in others *double;* but these peculiarities appear in all cases to be characteristic of each distinct genus. In conclusion, he confirms the observation already made by M. Gervais, that the number of eyes is increased as the animal advances in its transformations. The author concludes by stating that he proposes continuing these observations on the Myriapoda at some future period.

The paper is accompanied by drawings of the parts described, and of the successive changes which take place during the developement of the animal.

The Society then adjourned over the long vacation, to meet again on the 18th of November next.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1841. No. 50.

November 18, 1841.

Lieutenant-Colonel EDWARD SABINE, R.A., V.P., in the Chair.

The following gentlemen were, by ballot, elected Auditors of the Treasurer's Accounts, on the part of the Society, viz. Neil Arnott, M.D., Francis Baily, Esq., William Hasledine Pepys, Esq., George Rennie, Esq., and Charles Wheatstone, Esq.

Captain William Allen, R.N., and Lieut.-Colonel Sir J. M. Frederic Smith, R.E., were balloted for, and duly elected Fellows of the Society.

The following papers were read :—

1. " Variations de la déclinaison et intensité magnétique horizontale observées à Milan le 28 et 29 Mai, le 23 et 24 Juin, le 21 et 22 Juillet, le 27 et 28 Août, et le 22 et 23 Septembre 1841." Par Sig[r]. Carlini, For. Memb. R.S.

2. " Variations de la déclinaison magnétique et de l'intensité magnétique horizontale observées à Bruxelles le 23 et 24 Juin, et le 21 et 22 Juillet 1841." Par M. A. Quetelet, For. Memb. R.S.

3. " Meteorological Register kept on board the Earl of Hardwicke, during a voyage from London to Calcutta and back to London, by Captain Alexander Henning." Communicated by Sir John F. W. Herschel, Bart., F.R.S., &c.

4. " Meteorological Register kept at Port Arthur, Van Diemen's Land, by Deputy-Assistant-Commissionary-General Lempriere, from Feb. 1, 1840, to Feb. 1, 1841." Communicated by Captain Beaufort, R.N., F.R.S., Hydrographer to the Admiralty.

5. " Term Observations of the Variation, Magnetic Declination, Horizontal Intensity, and Inclination at Prague, for June, July, August and September 1841." By Professor Kreil. Communicated by S. Hunter Christie, Esq., Sec. R.S.

November 25, 1841.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

The Right Honourable the Earl of Lovelace was balloted for, and duly elected a Fellow of the Society.

The following papers were read, viz.—

1. "Explanation of the construction, positions, comparisons, and times of observation, of the Meteorological Instruments at the Royal Observatory, Greenwich, with which the Observations have been made that are contained in the sheets of Meteorological Observations, forms 1 and 2, for each month from 1840 November to 1841 July, both inclusive, sent to the Royal Society in 1841, October 26." By George Biddell Airy, Esq., M.A., F.R.S., Astronomer Royal.

2. "On the Laws of the rise and fall of the Tides in the River Thames." By George Biddell Airy, Esq., M.A., F.R.S., Astronomer Royal.

The conclusions arrived at by the author, and stated in this paper, were derived from an extensive series of observations of the tides, made, on his suggestion, at the Royal Victualling Yard at Deptford, under the superintendence of Captain Shireff, R.N. The object of the first series of observations was simply to ascertain the times of high and low water, for the purpose of ascertaining the duration of the rise and fall of the tide: the height of the water was observed at every quarter of an hour, night and day, during half a lunation. The curves representing the law of rise and fall of the water were found to be different for high tides and for low tides; and both are sensibly different from the line of sines. The author then investigates mathematically the motion of a very long wave, such as a tide-wave, in a rectangular canal, whose section is everywhere the same, on the supposition that the extent of vertical oscillation bears a sensible proportion to the mean depth of the water; and deduces an expression for the vertical elevation of a particle at the surface. This expression supposes the canal unlimited at the end farthest from the sea. If the canal be stopped by a barrier, the expression changes its form. The formulæ obtained by the author enable him to explain a circumstance, hitherto perplexing, namely, that the age of the tide is different as inferred from the height of the high water, or from the time of high water; being always greater in the former mode of estimation.

3. "Register of Tides, observed at Coringa, from January 1st to June 30th, 1841."

4. "Meteorological Journal, from the 20th April 1840 to the 29th April 1841. Kept at the Falkland Islands on board H.M. Ketch, Arrow."

5. "Daily Thermometrical Observations at Cape Palmas, for May 1841."

These last three papers were communicated to the Society by the direction of the Lords Commissioners of the Admiralty.

November 30, 1841.

At the Anniversary Meeting,

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

Francis Baily, Esq., on the part of the Auditors of the Treasurer's Accounts, reported, that the total receipts during the last year, inclusive of a balance of 937*l.* 19*s.* 7*d.*, carried from the account of the preceding year, amounted to 3874*l.* 14*s.* 9*d.*; and that the total payments in the same period amounted to 3265*l.* 12*s.* 1*d.*, leaving a balance in the hands of the Treasurer of 609*l.* 2*s.* 8*d.*

The thanks of the Meeting were given to the Auditors, for the trouble they have taken in examining the Treasurer's accounts.

The thanks of the Meeting were also voted to the Treasurer, for his services to the Society.

The following Letter from the President addressed to the Society, was read:—

GENTLEMEN,

I regret extremely that my absence from England will prevent my having the honour and pleasure of meeting you at the Anniversary of the Royal Society. The Council will therefore perform the duty, which would otherwise have fallen on me, of adverting to the continued prosperity of our Society, to the losses which it has, however, undergone in the course of nature, and to the adjudication of our Medals. This duty I am sure that they will perform better than I could do, so that, in that point of view, you will be no losers; the loss of a great pleasure in meeting so many scientific friends will fall on myself; but I look forward to the spring, when I hope again to meet you, both in my own house and at our ordinary weekly Meetings. Meanwhile the Royal Society has, as it ever will have, my most earnest wishes for its prosperity and its success, in carrying forward the great object for which it was established—the increase of human knowledge in every department of physical science.

The Vice-President in the Chair informed the Meeting that the Council had voted the following Address to Her Majesty the Queen:—

"*To the Queen's most Excellent Majesty.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"MOST GRACIOUS SOVEREIGN,

"We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for im-

proving Natural Knowledge, approach Your Majesty to offer our humble and heartfelt congratulations on the birth of the Heir to the Throne of the British Empire. The Almighty Disposer of events has vouchsafed to Your Majesty His protection in a season of much pain and peril; and we pray that a life so dear to Your Majesty's subjects may long be preserved, through the same Divine Grace.

"We ardently hope that Your Majesty's Son may be endowed with health and strength; that he may be adorned with every virtue which can dignify his station; and we pray that Your Majesty may continue to be blest with all prosperity."

The Vice-President in the Chair also stated to the Meeting that the Council had adopted the following Address to His Royal Highness Prince Albert of Saxe-Coburg and Gotha:—

"*To His Royal Highness Prince Albert of Saxe-Coburg and Gotha, K.G., F.R.S.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to approach Your Royal Highness with our most sincere congratulations on the safety of Your Royal Highness's Consort, our beloved Sovereign, and on the birth of His Royal Highness the Duke of Cornwall. It is our most earnest wish that Your Royal Highness may enjoy every domestic blessing, and may witness the maturity of Your Son in every manly virtue."

The Secretary then read the following

Report of the Council to the Society.

The Council have the satisfaction of being able to report to the Society, that the system of Magnetical and Meteorological Observations proposed by the Royal Society, and carried on at various stations on the globe, at the fixed observatories established by the governments of this and of other countries, is at present in full and active operation; and that an immense mass of documents, relating to terrestrial magnetism and meteorology, is in progress of collection, from which it may reasonably be expected that, after they shall have been properly arranged and digested, the most valuable results, advantageous both to physical science and to practical navigation, will be derived. It may also be noticed, in connexion with this subject, that the series of instructions to the officers of the expedition lately sent out to Africa, for conducting magnetic observations, prepared by Lieut.-Colonel Sabine, has been adopted by the Council, and communicated to the Lords Commissioners of the Admiralty.

The Council have received with gratitude the intimation, com-

municated by the Baron de Brunow, of the earnest desire of the Russian Government to co-operate in the magnetical inquiries now carrying on in various parts of the world. A paper, containing supplemental instructions for the use of the Magnetical Observatories, drawn up by Professor Lloyd, has also, with the sanction of the Council, been recently printed and circulated.

The Astronomer Royal having suggested, that observations on Atmospheric Electricity might with advantage be made at the Meteorological Observatory at Greenwich, the Council, on the advice of the Committee of Physics, have concurred in these views, and have ordered that the requisite instruments should be procured for the purpose of carrying them into effect.

Reference was made to the Council, on the 10th of December last, by the Lords Commissioners of the Admiralty, for their opinion, both of the absolute and the relative merits of certain improvements in the construction of Chronometers, for which rewards were claimed by the inventors. In compliance with this request, the Council appointed a Committee, consisting of the Astronomer Royal, Mr. Wheatstone, and the Rev. R. Willis, to conduct the inquiry and communicate the result to the Council. This task they have accomplished, and have made an able report, which was laid before the Council, and adopted by them on the 10th of June.

A large number of boxes and casts, containing specimens of natural history, received by the Lords of the Admiralty from the Antarctic Expedition, having been sent by them to the Royal Society, with a view to their being placed, or caused to be placed, in such hands as were most likely to secure their present safe custody, and accompanied with the condition that they should not be alienated, nor described in publications before the return of the expedition, the Council, in conformity with this request, have transmitted them to the British Museum, together with the intimation of the wishes of the Lords of the Admiralty relative to their preservation.

The Council have to express their especial thanks for two presents made to the Society: the first, from Charles Vignolles, Esq., of an original portrait of Sir Isaac Newton, painted by Vanderbank; the second, of a portrait of Dr. Dalton, painted by B. R. Faulkner, Esq., which was presented by a Committee appointed at Manchester for procuring a memorial of the distinguished merits of that philosopher.

Report on the state of the Society's Library.

The alterations in the Library of the Society, occasioned by the erection of the gallery, by the removal of the presses from the fireplace, and by the dislocation and re-union of the tracts, having necessarily created much irregularity and confusion, the Council, being desirous of rendering the Library as available as possible to the Members of the Society, have turned their attention, during the last session, to provide greater facilities for reference and consultation, by adopting a new collocation of the books. With this view, after having expended the sum appropriated by the Council for the bind-

ing of all the books that required it, the Library Committee proceeded to consider, first, the means of gaining greater space on the shelves, by collecting together, as far as it was practicable, books of a similar size; and secondly, by adopting a classed arrangement, so that the places occupied by the books should correspond, as nearly as their sizes would admit, with their order in the Catalogue. The Council have the satisfaction of reporting, that this useful and laborious work has, by the great exertions of the Librarian during the summer recess, been effectually performed; and they congratulate the Society on the greater advantages which they will derive from the possession of their extensive collection of books in every department of mathematical and physical science, by the increased facilities now afforded of finding readily any book that may be wanted.

The Council have also to announce that a Catalogue has been made of the books relating to Miscellaneous Literature in the Society's Library. Copies of this Catalogue are now ready for distribution to the Fellows.

The Society is probably aware that, during the preceding year, a Catalogue has been made, in conformity with the directions of the Council, by James Orchard Halliwell, Esq., F.R.S., of the Miscellaneous Manuscripts, comprising highly interesting correspondence of many learned men with the Society, from its first formation to nearly the middle of the eighteenth century.

The re-arrangement of the Library being now completed, it will probably be satisfactory to the Society to know its contents and condition. The Librarian has accordingly been requested to draw up a summary, of which the following is an abstract:—

The total number of bound volumes contained in the Library amounts to	19,045
Besides which, there are contained in it unbound Reports of the House of Commons, in number.	823
There are also 810 unbound tracts, which would form, if bound together, a number of volumes about . . .	150
So that the total number of volumes may be estimated at	20,018

Of these, there are of Scientific volumes	8304
——— Miscellaneous Literature	5049
——— Transactions	2076
——— Journals	3616

Although this is an exact enumeration of the volumes contained in the Library, it is scarcely a just appreciation of their number, from the circumstance of there being, in a multitude of instances, two or three volumes bound in one. The Librarian is not sufficiently prepared, at the present moment, to give satisfactorily the exact number of these, or of the distinct works, throughout the Library and in the different classes; for the precise numbers of volumes in these classes cannot as yet be ascertained. But that the Library is much richer than it would seem from the above enumeration, appears from the circumstance, that, in the Scientific division, 592 volumes con-

tain 3883 distinct tracts; and, in the Miscellaneous portion, 173 volumes contain 1402 tracts. Thus 765 volumes of the above total of 20,018 volumes, comprise as many as 5285 separate works.

The Library contains, besides, a valuable collection of Oriental Manuscripts, especially Sanscrit, formed by Sir William Jones during his residence in the East, and presented to the Society, after his decease, by Lady Jones. Many of these are unique in Europe; and their value is attested by learned foreigners coming to this country for the express purpose of consulting them. Of the Miscellaneous Manuscripts, the autograph of the *Principia*, presented by Sir Isaac Newton to the Society, and from which the first edition was printed, must be considered invaluable. An unpublished MS. of Aubrey's is also in the Library, and contains curious researches frequently referred to by antiquaries. The collection likewise contains MSS. of Pappus Alexandrinus, Statius, Jordanus, Nemorarius, Malpighius, John Robins, &c. The Catalogue of Miscellaneous Literature is peculiarly valuable, as containing autograph letters of the majority of distinguished individuals throughout Europe since the first formation of the Society; for instance, of Newton, Leibnitz, Wren, Hevelius, Huygens, Lister, Ray, Willoughby, &c. &c.

The Library possesses, besides, a large collection of Maps and Charts, and many Engravings; but of these no catalogue is as yet published.

In almost every department of Science, the Library contains all the most valuable works, especially in the mathematical sciences.

In the Miscellaneous division of the Library, the largest proportion of which was acquired by the bequest of the Earl of Arundel, the Library possesses some very interesting books, especially some of the early works of the fifteenth and sixteenth centuries, and many *Editiones principes* of the Classics. The majority of these came into the possession of the Earl of Arundel by the purchase of the library of the celebrated Bilibaldus Pyrckheimer; particularly the jurists and the early reformers. Of these, the first editions of many of Luther's tracts are interesting. There are, besides, some curious collections of Italian and Spanish poetry.

The earliest printed book in the Library is a splendid copy upon vellum of the Decretals, printed by Fust in 1465, and Tully's Offices, also on vellum, by Fust in 1466; and there are specimens of many of the early German and Italian presses. Of our own, there are copies of Caxton's second edition of Chaucer's Canterbury Tales, and Pynson's first edition of the same works, the first half of which was revised by Caxton. Neither have dates; but the former is supposed by Tyrwhit to have been printed about 1482, and the latter about 1493. With these exceptions, the Library contains but few early English books; for the second folio edition of Shakspeare cannot be so called, as there are scientific books of an earlier date than this in the Library. There are also the majority of the books printed by the Record Commission and by the Oriental Translation fund.

Awards of Medals.

The Council has awarded the Copley Medal for the present year to Dr. G. S. OHM, of Nuremberg, for his researches into the laws of Electric Currents, contained in various memoirs published in Schweigger's Journal *, Poggendorff's Annalen, and also in a separate work, entitled *Die Galvanische Kette Mathematisch Bearbitet*, published at Berlin in the year 1827. In these works, Dr. Ohm has established, for the first time, the laws of the electric circuit; a subject of vast importance, and hitherto involved in the greatest uncertainty. He has shown that the usual vague distinctions of intensity and quantity have no foundation, and that all the explanations derived from these considerations are utterly erroneous. He has demonstrated, both theoretically and experimentally, that the action of a circuit is equal to the sum of the electro-motive forces divided by the sum of the resistances; and that whatever be the nature of the current, whether voltaic or thermo-electric, if this quotient be equal, the effect is the same. He has also shown the means of determining with accuracy the values of the separate resistances and electro-motive forces in the circuit. The light which these investigations has thrown on the theory of current electricity is very considerable; and although the labours of Ohm were, for more than ten years, neglected, (Fischner being the only author who, within that time, admitted and confirmed his views,) within the last five years, Gauss, Leng, Jacobi, Poggendorff, Henry, and many other eminent philosophers, have acknowledged the great value of his researches, and their obligations to him in conducting their own investigations. Had the works of Ohm been earlier known, and their value recognised, the industry of experimentalists would have been better rewarded. In this country those who have had most experience in researches in which voltaic agency is concerned, have borne the strongest testimony to the assistance they have derived from this source, and to the invariable accuracy with which the observed phenomena have corresponded with the theory of Ohm. This accordance, it may be observed, is altogether independent of the particular hypothesis which may be adopted as to the origin of electro-motive force; and obtains equally, whether that force is regarded as being derived from the contact of dissimilar metals, or as referable to chemical agency.

* 1. On the electric conductibility of the metals. (Schweigger's Journal, second series, vol. xiv.)

2. Experiments to discover the power of electro-magnetic multipliers. (Ibid. vol. xxv.)

3. Researches to ascertain the nature of unipolar conductors. (Ibid. vol. xxix.)

4. On hydro-electric currents. (Ibid. third series, vol. iii.)

5. Statement of facts destroying the relations which have been confusedly established between several galvanic properties, and particularly hydro-electric conductors. (Ibid. vol. v.)

6. Theory of galvanic currents. (Ibid. vol. vii.)

The Council have awarded one of the Royal Medals for this year, which had been proposed for the subject of Chemistry, to ROBERT KANE, M.D., M.R.I.A., Professor to the Royal Dublin Society, for his paper "On the Chemical History of Archil and Litmus," published in the Philosophical Transactions for 1840.

It has been found that various lichens, which communicate no colour to pure water, strike a fine blue with solution of ammonia. The valuable colouring matters archil, litmus and cudbear, are commercial preparations of these lichens. Some progress had already been made in the investigation of their colouring principles by the labours of Robiquet, Heeren, and Dumas; of which the most important step was the discovery of *Orcine,* and also of *Orceïne,* into which the former is converted by ammonia; but the observations were isolated, and the whole subject was in the greatest obscurity. The present memoir by Dr. Kane records the first attempt to sketch a general history of the class: and, considering the great and peculiar difficulties attending inquiries into organic colouring matters, the attempt may be esteemed eminently successful. It proved an investigation of considerable intricacy and great extent, involving several hundred organic analyses; and it has been conducted in a manner highly creditable to the author's skill as an analyst. The paper contains an account of the discovery of a large number of new compounds, not less than twelve, derived from archil and litmus, together with the more exact discrimination of several others, already known, but imperfectly described. The distinction made of two *Orceïnes,* which have hitherto been confounded as one, is a striking result contained in the paper: while the observations on the action of chlorine and of nascent hydrogen upon several of the bodies described, open new branches of inquiry.

The objects which the author had in view in these inquiries were the three following: namely, first, to ascertain the primitive form of the colour-making substance in a given species of lichen, and trace the stages through which it passes before the coloured substance is developed; secondly, to determine the nature of the various colouring substances which exist in the archil of commerce; and thirdly, to examine the colouring materials of ordinary litmus. He finds in the lichen *Roccella tinctoria* the following bodies, either pre-existing in the plant, or formed during the processes employed for its analysis: 1. Erythryline; 2. Erythrine (the Pseudo-erythrine of Heeren); 3. Erythrine bitter; 4. Telerythrine; and 5. Roccelline (the Roccellic acid of Heeren). The properties and constitution of these substances are then described, and the chemical formulæ given, which are deducible from their respective analyses. The author finds the archil of commerce to consist essentially of three ingredients, namely, orceïne, erythroleic acid, and azoerythrine; of each of the two former there exist two modifications, and there is, in addition, a yellow matter. After comparing his results with those obtained by Heeren, by an examination of the products evolved by his erythrine in contact with air and with ammonia, and stating reasons for some changes in nomenclature, the author gives the chemi-

cal formulæ resulting from his own analysis of these different substances.

His inquiries into the constitution of ordinary litmus, which form the last division of his subject, lead him to the conclusion that that substance contains the principles designated by him as Erythrolein, Erythrolitmine, Azolitmine, and Spaniolitmine; and that the colouring constituents of litmus are, in their natural condition, red; the blue substances being produced by combination with a base, the bases in that of commerce being lime, potass, and ammonia; and there is mixed up in the mass a considerable quantity of chalk and sand. The details of the analyses of these several substances, and the resulting chemical formulæ representing their constitution, are then given.

The concluding section of the paper is occupied by an inquiry into the decoloration of the bodies which exist in archil and in litmus. The latter of these, the author concludes, is reddened by acids, in consequence of their removing the loosely combined ammonia by which the blue colour is produced; and the so-called hydrogen-acids liberate the colouring matter by their combining with the alkali to form bodies (either chlorides or iodides), with which the colouring matter has no tendency to unite. Hence it appears that the reddening of litmus is no proof that chloride of hydrogen is an acid, and that the double decomposition which occurs is the same in principle, whether hydrogen or a fixed metal come into play. After detailing the blanching effects of other deoxydizing agents on the colouring matter of litmus, and the action of chlorine on orceïne and azolitmine, the author remarks, that in these actions chlorine is subjected to conditions different from those which determine the nature of the results with the generality of organic bodies, and that the displacement of hydrogen, so marked in other cases, does not exist in the class of substances under consideration; but that, in reality, the products of the bleaching energy of chlorine resemble in constitution the compounds of chlorine which possess bleaching powers.

This paper may be viewed as a very important contribution to organic chemistry, and as highly deserving of the Royal Medal; an award which will, doubtless, be hailed by chemists as a just encouragement to perseverance in skilful analytical research.

There being no paper on Mathematics coming within the stipulations regulating the awards of the Royal Medals, which has been deemed worthy of that for Mathematics in the present year, the Council have, in virtue of the power given to them, under these circumstances, by the regulations prescribed by Her Majesty, awarded the other Royal Medal to EATON HODGKINSON, Esq., for his paper, which was published in the Philosophical Transactions for 1840, and is entitled "Experimental Researches into the Strength of Pillars of Cast Iron, and other materials."

This paper has been esteemed by the Council to be peculiarly valuable in a practical as well as theoretical point of view, and therefore to deserve, in an eminent degree, the honour of a Royal Medal. It contains the results of an immense series of experiments, conducted

with great patience and admirable skill, and at a very considerable cost. Mr. Hodgkinson's position among the manufactories of Manchester, together with the unlimited command over the resources of one of the largest engineering establishments, which he obtained through the liberality of its proprietor Mr. Fairbairn, enabled him to direct his inquiries to the forms of pillars which are found most useful in practice. The results of his labours he has reduced to empirical formulæ, peculiarly adapted for application to the purposes of mechanical art.

Among the most useful of the practical conclusions to which he has arrived, the following are more particularly deserving of notice.

Mr. Hodgkinson has found, that in all long pillars of the same dimensions, the resistance to crushing by flexure is about three times greater when the ends of the pillars are flat, than when they are rounded. A long uniform cast-iron pillar, with its ends firmly fixed, whether by means of discs or otherwise, has the same power to resist breaking as a pillar of the same diameter, and half the length, with the ends rounded, or turned so that the force would pass through the axis. The strength of a pillar with one end round and the other flat, is the arithmetical mean between that of a pillar of the same dimensions with both ends round, and one with both ends flat. Some additional strength is given to a pillar by enlarging its diameter in the middle part.

The strength of long cast-iron pillars with relation to their diameter and length is also made the subject of Mr. Hodgkinson's investigations; and the result he deduces from them is, that the index of the power of the diameter, to which the strength is proportional, is 3·736. He has also determined, by a comparison of experimental results, the inverse power of the length to which the strength of the pillar is proportional. The highest value of this power he finds to be 1·914, the lowest 1·537, and the mean of all the comparisons 1·7117. He thus deduces, first, approximate empirical formulæ for the breaking weight of solid pillars, and afterwards, more correct methods of determining their strength. From experiments on hollow pillars of cast-iron, formulæ representing the strength of such pillars are, in like manner, deduced.

The strength of pillars of wrought iron and of timber, in relation to their dimensions, is made the subject of another series of experiments. The result for wrought iron is, that the strength varies inversely as the square of the length of the pillar, and directly as the power 3·75 of its diameter, the latter being nearly identical with the result obtained for cast iron; while in timber, the strength varies nearly as the fourth power of the side of the square forming the section of the pillar. In like manner, the power of cast-iron pillars to resist long-continued pressure, and the relative strengths of long pillars of cast iron, wrought iron, steel and timber, are determined.

The inquiry which constitutes the subject of this paper is not, however, the first of the kind in which Mr. Hodgkinson has been engaged; several series of experiments and papers on the strength of iron, in various forms, have been published by him at different

times; and their accuracy has established his claim to our confidence on the present occasion.

The several medals, thus awarded, were then delivered, with appropriate addresses, by the Vice-President in the Chair.

The Copley Medal, adjudicated to Dr. Ohm, was, in the absence of Professor Daniell, the Foreign Secretary, delivered to Dr. Roget, in order that it may be forwarded to its destination.

The Royal Medal, adjudicated to Dr. Kane, was delivered to Francis Baily, Esq., whom Dr. Kane had deputed to receive it for him.

The other Royal Medal, adjudicated to Eaton Hodgkinson, Esq., was delivered to himself.

List of Admissions into the Royal Society since the last Anniversary (1840).

James Alderson, M.D.
Charles Dickson Archibald, Esq.
David Francis Atcherley, Esq.
Sir Thomas Baring, Bart.
Peyton Blackiston, Esq.
Edward Blore, Esq.
William Bowman, Esq.
Henry Rowland Brandreth, Esq.
The Rt. Hon. George Stevens Byng.
Samuel Cartwright, Esq.
John Clendinning, M.D.
Hart Davis, Jun., Esq.
Rev. Joshua Frederick Denham, M.A.
Joseph Edye, Esq.
Charles Enderby, Esq.
Earl de Grey.
William Robert Grove, Esq.
Eaton Hodgkinson, Esq.
Rev. John Hoppus, LL.D.
Julius Jeffereys, Esq.
Sir Richard Jenkins.
Robert Masters Kerrison, M.D.
Henry Gally Knight, Esq., M.P.
Robert Lister, Esq.
Lord Viscount Melbourne.
James Cosmo Melvill, Esq.
Lord Monteagle.
Samuel Seaward, Esq.
Edward James Seymour, Esq,
Robert W. Sievier, Esq.
Alfred Smee, Esq.
Lt.-Col. Sir J. M. Frederic Smith, R.E.
Henry Harpur Spry, Esq.
Rev. Mark Aloysius Tierney.
Lord Vivian.
The Marquis of Westminster.
Lieut.-Col. Thomas Wood.
Charles Woodward, Esq.
Lord Wrottesley.

List of Fellows of the Royal Society deceased since the last Anniversary (1840).

On the Home List.

Francis Bauer, Esq.
Sir Francis L. Chantrey, Knt.
Sir Astley Paston Cooper, Bart.
Lieut.-Gen. Sir Rufane Shaw Donkin, K.C.B.
Neil Benj. Edmonstone, Esq.
Robert Ferguson, Esq.
Sir George Harrison, Knt.
John Hawkins, Esq.
James Hope, M.D.
The Rt. Hon. Sir Robert J. W Horton, Bart.
James Rawlins Johnson, M.D.
John Knowles, Esq.
Captain John Lihou, R.N.
Alexander Melville, Esq.
George Watson Taylor, Esq.
John Whishaw, Esq.
Sir John Wesley Williams, Knt.
The Lord Bishop of Worcester (Dr. Robert James Carr)

On the Foreign List.

Augustin Pyramus De Candolle, of Geneva.

The two following names of Fellows who died in the year 1840 were omitted in the report of last year, and require, therefore, to be noticed in the present report:

Simon L'Huillier, of Geneva.
Félix Savart, of Paris.

Ceased to be Fellows in default of their annual payments,

Francis Corbaux, Esq.
Edmund S. Halswell, Esq., M.A.
The Rev. Dionysius Lardner, LL.D.

The Vice-President in the Chair having called upon Dr. Roget, the senior Secretary, to read to the Meeting the biographical memoirs which he had written of some of the Fellows lately deceased,

Dr. Roget begged leave to observe, that, for many years past, it has been customary for the President, in his anniversary addresses to the Society, to give narratives of the leading incidents in the lives, and an account of the scientific labours of the more distinguished associates of whom death had deprived us during the preceding year. The utility of such a retrospect, he remarked, is sufficiently obvious. Consolation may be afforded to the survivors by the just tribute thus publicly paid to the memory of those they mourn. In marking the several steps of their ascent to eminence, in retracing the services they have rendered to science and to mankind, and in establishing their respective claims to our respect, our admiration and our gratitude, fresh motives of emulation are presented to those who are following in the same arduous paths, and aspiring to the same honourable distinctions. The Society can never forget how well these objects have been fulfilled by the excellent biographical notices we have been accustomed to hear from our Presidents on each returning anniversary, and must feel how much reason they have to regret the omission of the usual discourse from the Chair on the present occasion. It is with a view to prevent this interruption of the series being drawn into a precedent, that Dr. Roget has now been induced, by the desire of the President, to attempt supplying, however imperfectly, the omission he has alluded to. Having but little leisure to perform this task, he wished to claim the indulgence of the Meeting for the many imperfections they will discover in the mode of its execution.

Of the deceased members on the home list, Dr. Roget has been able to notice only two, namely, Mr. Bauer and Sir Astley Cooper, not having received, with regard to the rest, any authentic information which was deserving of record in this place. It is impossible for him, however, to pass over in complete silence the honoured name of one, whose loss within these few days we all so deeply deplore— the late SIR FRANCIS CHANTREY*. But the calamity is too recent

* He was born in 1782, and expired quite suddenly on the 25th of the present month (Nov. 1841); only five days before the present meeting.

and too sudden to afford the opportunity, if indeed the effort could, under these painful circumstances, have been made, of collecting the materials for a narrative which might render adequate justice to his superior merits as an artist, and to his exemplary character as a man. This tribute to his memory must be reserved for a period when his biographer will be able to review the subject more extensively, and with more calm deliberation.

FRANCIS BAUER was born at Feldsberg, in Austria, on the 4th of October, 1758. While yet a boy he lost his father, who held an appointment as painter to Prince Lichtenstein; so that the care of his education devolved upon his mother. He manifested very early a talent for botanical drawing; and the first published production of his pencil, at the age of thirteen, was a figure of the *Anemone pratensis* appended to a work of Stoerck. He came to England in the year 1788, and was about to proceed to Paris; when, on the eve of his intended departure, he was offered by Sir Joseph Banks the appointment of draughtsman at the Royal Gardens at Kew, a proposal which induced him to relinquish his intentions of leaving England. He took up his residence near those Gardens, and he continued to dwell, during the remainder of his life, in their neighbourhood. The salary of the new office which Mr. Bauer held was defrayed by Sir Joseph Banks during his own life, and its continuance after his decease was provided for by his will.

Mr. Bauer, in fulfilment of his engagement, made numerous drawings and sketches of the plants in the Garden; and these are now preserved in the British Museum. A selection from his drawings was published in 1796, under the title of "Delineations of Exotic Plants cultivated in the Royal Gardens at Kew," containing in all thirty plates of different kinds of Heaths. His drawings have also illustrated several papers published in the Linnæan Transactions, and particularly those of Mr. Brown. The 13th volume of that work contains a paper by Mr. Bauer on the Ergot of Rye, drawn up from materials collected between the years 1805 and 1809; and the plate which illustrates it is derived from drawings forming part of an extensive series in the British Museum, illustrating the structure of the grain, the germination, growth and developement of wheat, and the diseases of that and other Cerealia. This admirable series of drawings constitutes perhaps the most splendid and important monument of Mr. Bauer's extraordinary talents as an artist, and of his skill in microscopic investigation. The subject was suggested to him by Sir Joseph Banks, who was engaged in an inquiry into the disease of corn known by the name of *blight*; the part of Mr. Bauer's drawings which relates to that disease was published in illustration of Sir Joseph's memoir on the subject, and has been several times reprinted with it. Mr. Bauer himself gave, in the volume of the Philosophical Transactions for 1823, an account of his observations on the *Vibrio tritici* of Gleichen, with the figures relating to them; and another small portion of his illustrations of the diseases of corn has since been pub-

lished by him in the 'Penny Magazine' for 1833. His figures of a somewhat analogous subject, the apple-blight, and the insect producing it, accompany Sir Joseph Banks's memoir on the introduction of that disease into England, in the second volume of the Transactions of the Horticultural Society.

Mr. Bauer had commenced, before the close of the last century, a series of drawings of Orchideæ, and of the details of their remarkable structure, to which he made additions from time to time, as opportunities offered, nearly to the termination of his life. A selection from these, which form one of the most beautiful and extensive series of his botanical drawings, was lithographed and published by Professor Lindley, between the years 1830 and 1838, under the title of "Illustrations of Orchidaceous Plants."

A paper by Mr. Bauer, entitled "Some Experiments on the Fungi which constitute the colouring matter of the Red Snow discovered in Baffin's Bay," was published in the Philosophical Transactions for 1820. By mixing the snow containing these fungi with water, he found that they could be made to vegetate, but that they produced new fungi of a green instead of a red colour. By exposure to excessive cold the primitive fungi are killed, but their seed still retains vitality, and, if immersed in snow, which appears to be their native soil, they reproduce new fungi, which are generally of a red colour.

The Philosophical Transactions for 1823 contains the paper by Mr. Bauer already alluded to, entitled "Microscopical Observations on the Suspension of the Muscular Motions of the *Vibrio tritici*," which forms the Croonian Lecture for that year. This minute worm, which infests wheat, and is the immediate cause of that destructive disease called the *Ear Cockle* or *Purples*, congregates in immense numbers in the substance of the grains thus diseased, forming masses of a white and apparently glairy mucus, which, when immersed in water, separate and exhibit, under the microscope, the worms in lively motion. After they have become perfectly dry, and apparently lifeless, they may be readily revived by being moistened with a drop of water, when they become as lively as before. Mr. Bauer determined, by a series of experiments, that the ova of these worms are conveyed into the cavities of the germens by the circulating sap. On inserting some of the worms into sound grains of wheat, and allowing them to germinate, he found the worms, in different stages of their growth, in the stalk, and ultimately in the germens of the new plant.

In the year 1816 he commenced lending the assistance of his pencil to Sir Everard Home, in the various anatomical and physiological investigations in which the latter was engaged; and in the course of ten or twelve years furnished, in illustration of Sir Everard's numerous papers in the Philosophical Transactions, more than a hundred and twenty plates, which were afterwards reprinted in his 'Lectures on Comparative Anatomy.' These plates, which form together the most extensive series of Mr. Bauer's published works, embraced a great variety of important subjects, chiefly in

microscopic anatomy, and afford abundant evidence of his powers of observation and skill in depicting the most difficult objects. It is this rare and previously almost unexampled union of the observer and the artist that has placed Mr. Bauer in the first rank of scientific draughtsmen. His paintings, as the more finished of his productions may well be termed, are no less perfect as models of artistic skill and effect, than as representations of natural objects.

He died at his residence on Kew Green, on the 11th of December last, in the 83rd year of his age*.

Sir Astley Paston Cooper, Bart., was the fourth son of the Rev. Dr. Samuel Cooper, of Yarmouth in Norfolk. His mother was a daughter of James Bransby, Esq., of Shottisham, and was known as the authoress of a novel entitled 'The Exemplary Mother.' Sir Astley was born at Brooke, in the same county, on the 23rd of August, 1768. Even in his boyhood he was noted for his bold and enterprising spirit, the sociability and kindness of his disposition, and for the animation with which he entered into all the sports of his juvenile companions. After receiving from the village schoolmaster, and from his father, who was a good scholar, some portion of classical instruction, he was placed, at the age of fifteen, with Mr. Turner, a surgeon and apothecary at Yarmouth. Here he remained but a few months, and was then sent to London, and bound apprentice to his uncle, Mr. William Cooper, one of the surgeons of Guy's Hospital, but was soon after transferred, by his own desire, to Mr. Cline, who had already attained great eminence, and was surgeon of St. Thomas's Hospital. This connexion afforded him ample opportunities of acquiring professional knowledge, under the guidance of a master distinguished by a truly philosophical mind, and for whom his pupil always felt the most profound regard and veneration. Young Cooper's labours in the wide field of observation thus open to him, both in the hospital and dissecting-room, were unremitting; and the practical information he there acquired formed the solid basis of his future fame. He made a short visit to Edinburgh in the year 1787, and, although only in his nineteenth year, was a distinguished member of the Royal Medical Society of that place. On his return to London, Mr. Cline, who was the teacher of anatomy, physiology and surgery at St. Thomas's Hospital, appointed him his demonstrator of anatomy, and soon after gave up to him a part of the anatomical lectures. Sir Astley also gained the consent of Mr. Cline and the other surgeons of the hospitals of Guy and St. Thomas, to give a course of lectures on the principles and practice of surgery, a subject which had previously only formed a part of the anatomical course. He had now full scope for the display of those talents which afterwards shone forth on the wider theatre of the world, in a profession of which he became the brightest ornament. At first he was attended only by fifty students; but

* The above account is chiefly an abridgement of that contained in the Proceedings of the Linnean Society for 1841, p. 101.

his class soon increased to four hundred, which was by far the largest that had been known in London. His popularity as a teacher rapidly increased: he made no attempts at displays of oratory, but always studied to render the subject which he treated as plain and intelligible as possible to his hearers, wisely avoiding distracting their attention by entering on controversial topics connected with physiology.

On the close of 1791, the year he commenced as a lecturer, he married the daughter of Thomas Cock, Esq., of Tottenham, who was a distant relation of Mr. Cline: but as a proof of his constant solicitude never to neglect the performance of any public professional duty, it is remembered that on the evening of the day on which the marriage ceremony was performed he delivered as usual his lecture, without the slightest intimation to his class of what had happened in the morning; and even at the time when he was most fully engaged in this exceedingly laborious practice, he never omitted to deliver his regular lectures at the hospital.

In 1792, after spending some months at Paris and attending the lectures of Dessault at the Hotel Dieu, and also those of Chopart, he commenced practice in London, taking up his residence in the city, where he dwelt for many years before he removed to the west end of the town. The popularity he enjoyed as a surgeon, and the extent of his practice, have probably surpassed that of any of his predecessors: and the large fortune which he acquired was the just and honourable reward of distinguished merit and the most unremitting application.

Sir Astley Cooper was elected a Fellow of this Society on February the 18th, 1802. He had previously contributed to the Philosophical Transactions two papers: the first entitled "Observations on the Effects which take place from the Destruction of the Membrana Tympani of the Ear*," and the second containing "Further Observations on the same subject, together with an Account of an Operation for the removal of a particular kind of Deafness †." The operation of puncturing the membrana tympani for the relief of that species of deafness which arises from an obstruction of the Eustachian tube, suggested itself from observing that, in several cases, an aperture in the membrane did not essentially diminish the powers of the ear, and that even its total destruction by disease is not followed by total deafness. Several cases are described in which the operation proved successful; but of course, when deafness proceeds from any other cause, the operation is not likely to be of the least benefit.

The other professional publications of Sir Astley are exceedingly numerous; they all bear the stamp of the peculiar character of his mind: simple and unaffected in point of style, and without pretension to elegance, they contain a plain relation of facts, unbiassed by preconceived theories, the fruits of a long and extended experience, and leading to sound practical conclusions. He never sought pecuniary advantage by his publications; and while he spared no ex-

* Phil. Trans. for 1800, Part I. p. 151.

† Phil. Trans. for 1801, Part II. p. 435.

pense in the execution of such engravings as were best calculated to afford instruction, he invariably published them at a low price.

His publications relate chiefly to the following subjects, namely, the anatomy and treatment of the various kinds of hernia; of aneurism; of spina bifida; of dislocations and fractures; of exostoses; of encysted tumors; the extraction of calculi from the bladder; the structure and diseases of the breast and of the testis. Among the last subjects to which he had particularly turned his attention was the structure and functions of the thymus gland.

The splendid anatomical and pathological museum which he had collected and created entirely by his own industry and labour, and chiefly within the few last years of his life, at a period when the ardour of most men for scientific pursuits begins to flag, consists of nearly three thousand preparations, each most exquisitely worked out, and the whole admirably arranged. The injected preparations are of unrivalled beauty, and show that he had acquired a facility and perfection in the art of anatomical injection quite peculiar to himself.

He was latterly engaged in an experimental investigation on the functions of the different parts of the brains of the lower animals. His health had suddenly declined a short time before his death, which happened on the 12th of February, 1841.

Sir Astley was left a widower in June 1827; the year following, he married the daughter of John Jones, Esq., of Derry Ormond, in Cardiganshire. He has left no children, and has bequeathed by his will the whole of his museum to his nephew, Mr. Bransby Cooper, and he has also left some property in the funds (namely, £4000 three per cent. consols), of which the interest is to be given as a triennial prize for the best original Essay or Treatise on given subjects in Anatomy, Physiology or Surgery, to be awarded by the Physicians and Surgeons of Guy's Hospital *.

Augustin Pyramus De Candolle, one of the most distinguished botanists of the present age, was born at Geneva on the 4th of February, 1778. The same year is also memorable by the death of Linnæus, the father of modern botany, which took place about three weeks before the birth of one, who was destined to emulate his fame in the same department of natural history. When seven years of age, De Candolle sustained a serious attack of hydrocephalus, a disease generally so fatal in its tendency, that the present affords a remarkable instance of complete recovery, after life had been, for many days, despaired of.

Possessing a remarkable facility of writing verses both in French and Latin, and having at the same time a keen relish for the study of history, young De Candolle at first resolved to make literature his profession; aspiring, as the summit of his ambition, to the fame

* The greater part of this memoir of Sir Astley Cooper, and especially the account of his early life, has been extracted from Pettigrew's 'Medical Portrait Gallery.'

of being a great historian. But this dream of his youth was effaced by a new taste, imbibed during a residence in the country, where he amused himself with examining the plants of the neighbourhood, and with writing their descriptions, before he had even opened a single book on botany. The few pages he there read of the volume of nature were sufficient to captivate his affections for the pursuit which henceforth became the dominant passion of his life. The botanical lectures of Professor Vaucher, which he attended in 1794, increased his ardour, and confirmed him in the resolution he had formed, of devoting himself to the cultivation of botany as his primary object, to which all other sciences, as well as branches of literature, were hereafter to be deemed subordinate, and to be followed merely as recreations from severer study.

A visit to Paris, which he made in 1795, gave him the opportunity of attending the lectures of Cuvier, Fourcroy, Vauquelin, and other distinguished Professors of that period, and of forming friendships with Desfontaines and Lamarck. He always prided himself in having been the pupil of Desfontaines, in particular, towards whom he continued through life to feel the warmest gratitude and affection.

The establishment of the Society of Physics and Natural History at Geneva, which took place, after his return, under the auspices of the celebrated De Saussure, gave a fresh and powerful impulse to his exertions; as was evinced by the numerous memoirs which he presented to that Society.

The state of Geneva being, soon after this period, absorbed into the French empire, De Candolle was induced to quit that city and attend the medical lectures in Paris; a course of study which, tending to enlarge his views of the physiology of organized beings, contributed greatly to the success with which he afterwards cultivated tho Philosophy of Botany. While at Paris, he founded, in conjunction with his friend M. Benjamin Delessert, the *Société Philantropique*. One of the first advantages resulting to the public from this institution was the distribution of economical soups throughout the different quarters of the city. Of this institution he was the active secretary for ten years; during which period another society was also formed under his direction and management for the *Encouragement of National Industry*.

In 1804 he gave lectures on Vegetable Physiology at the "Collège de France," and published an outline of his course in 1805, in the *Principes de Botanique* prefixed to the *Flore Française*.

In 1806 he was commissioned by the French Government to collect information on Botany and the state of Agriculture through the whole of the French empire, the limits of which, at that time, extended beyond Hamburgh to the north, and beyond Rome to the south. Every year, during the following six years, he took a long journey in the fulfilment of the task assigned him, and drew up a report of his observations for the minister. In these annual reports, however, he did not confine himself to the special objects of his commission, but made known his views with regard to the internal ad-

ministration of the countries he visited, suggesting at the same time measures for their amelioration, and for the correction of existing abuses. He had projected a great work on the agricultural state of the empire, and had even executed considerable portions of it, comprehending the French Flora arranged according to modern views of classification, when the political events of 1814 put an entire stop to the work.

In 1808 he was appointed Professor of Medicine at Montpellier: and in 1810, a chair of Botany was instituted in the same Academy, which he was invited to occupy. Under his superintendence, the Botanical Garden of that city was more than doubled in extent, and the study of Botany assumed a degree of importance it had never before possessed. De Candolle quitted Montpellier in 1816, very much to the regret of the students and of his colleagues, who employed every means in their power to induce him to remain among them: but his country had been restored to liberty, and he was firm in his determination to fix himself in his native city, and devote to its services the remainder of his days.

Soon after his return to Geneva he was appointed to the chair of Natural History, an office which had been created expressly that he might occupy it. Among the first of the public benefits which he conferred upon his countrymen was the establishment of a Botanic Garden. The government of Geneva willingly lent their aid in forming so laudable an institution, in which he was also assisted by a great number of voluntary subscribers. The enthusiasm which he inspired for his favourite science was remarkably displayed on one particular occasion, when, being desirous of procuring for Geneva a copy of a Flora of Mexico which had been deposited with him for a few days, an appeal which he made to the public was responded to with such alacrity, that in the course of eight days, one thousand drawings had been finished by amateurs, who volunteered their services on the occasion.

The activity and powers of De Candolle's mind were displayed in a multitude of objects of public utility, the furtherance of which ever called forth in him the most lively interest;—whether it was the improvement of agriculture, the cultivation of the fine arts, the advancement of public instruction, the diffusion of education, or the amelioration of the legislative code. Feeling deeply of what vast importance to the welfare of mankind it is that sound principles of political economy should be extensively promulgated and well understood by all ranks of men, De Candolle never failed to develope and enforce those principles in his lectures and popular discourses, as well as in his official agricultural reports. On these subjects, and especially with respect to the immense advantages which would accrue to the community from the unrestricted freedom of commerce, his views were those of the most enlightened policy, and exhibited a sagacity in advance of the times in which he lived.

As a lecturer, he possessed in an eminent degree the power of imparting to his auditors the enthusiasm which glowed within his own breast for the pursuits of natural history. Complete master of the

subject of his discourse, his ample stores of knowledge never failed to supply him with illustrations; and even in his extempore effusions, all his ideas were developed in the clearest order, and explained with singular perspicuity *. His chief delight was to afford assistance of every kind to such students as needed it, and in whom he perceived a desire of improvement. His great aim was to inspire and diffuse a taste for the study of botany by rendering it popular among all ranks. His library, which contained the richest collection of works on that subject, and the volumes of his *hortus siccus*, were always open to those who wished to consult them. Often has he been known to discontinue researches which he had commenced, on finding that a similar design was entertained by another person; and he hastened, on these occasions, to communicate to this inquirer his own views on the subject, to place in his hands the materials he had collected, and to put him in possession of the fruits of his own experience. His sole object was the advance of knowledge; and whether this was effected by himself or by others was to him a matter of total indifference.

De Candolle had been visibly declining in health for some years before his end. The sudden death of Cuvier had impressed him with the apprehension that a similar fate might be impending; and that he himself might, in like manner, be cut off before he had accomplished the great works in which he was then engaged. He, in consequence, resolved to set aside all other occupations, and concentrate all his efforts in completing those more important designs. During the last year of his life he undertook, with the vain hope of improving his strength, a long journey, in the course of which he attended the scientific meeting held at Turin, where, as might be expected, he met with the most flattering and cordial reception. His death took place on the 9th of September, 1841, in the 64th year of his age †.

* The substance of De Candolle's popular courses of lectures on the physiology of plants is contained in 'Conversations on Vegetable Physiology; comprehending the Elements of Botany, with their application to Agriculture,' by the accomplished authoress of 'Conversations on Chemistry,' 'Natural Philosophy,' and other well-known works. The first edition appeared in 1829.

† An oration by M. Rigaud, the Syndic of Geneva, pronounced at the "*Conseil Réprésentatif*," on the 27th of September, is the source which has supplied the information here given with regard to De Candolle. The following is a catalogue of such of his works as are in the library of the Royal Society:—

1. Essai sur les propriétés médicales des plantes, comparées avec leurs formes extérieures et leur classification naturelle. 8vo. Paris, 1816.

2. Regni vegetabilis systema naturale; sive ordines, genera, et species plantarum secundum methodi naturalis normas; vol. 1 et 2: 8vo. Parisiis, 1818 et 1821.

3. Théorie élémentaire de la Botanique, seconde édition, 8vo. Paris, 1819. (The first edition appeared in 1813.)

4. Prodromus systematis naturalis regni vegetabilis; sive enumeratio contracta ordinum, generum, specierumque plantarum hucusque cognitarum

Simon L'Huillier, for many years Professor of Mathematics at Geneva, was born in that city on the 24th of April, 1750. The rapid progress which he made in his collegiate studies was viewed with so much interest by one of his relations, a minister of the reformed church of Geneva, that he bequeathed him a large portion of his fortune, on the express condition that he would embrace the clerical profession: but young l'Huillier, feeling no inclination to the studies which this condition would have imposed upon him, resisted the temptation, and preferred devoting himself to the pursuits of abstract science. The spirit of independence evinced by this sacrifice, together with the extraordinary aptitude he displayed for mathematical acquirements, excited the interest and conciliated the affection of another of his relations, the celebrated Le Sage, by whose instructions and counsels the most salutary influence was exercised over the studies of his pupil. Bertrand, who then occupied the chair of Mathematics in the same college, was also one of those who discerned in l'Huillier the dawn of genius; and even at that early period he regarded him as destined to be his successor in that professorship.

As l'Huillier advanced to manhood, it became necessary for him to engage in some active employment, in which he could turn to account his academical attainments. He had the good fortune, at this critical time of his life, to be chosen tutor to Prince Czartoryuski, with whom he remained for a period of thirteen or fourteen years; ever honoured with the friendship and respect of all the members of the Prince's family. He dedicated to the father of his pupil his first work, which was published at Warsaw in 1782, under the title of *De relatione mutuá capacitatis et terminorum figurarum,*

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juxta methodi naturalis normas digesta: partes I.—IV. 8vo. Parisiis, 1824—1830.

5. Mémoire sur la famille des Légumineuses; 4to. Paris, 1825.

6. Plantes rares du Jardin de Genève; livraisons I.—III.; 4to. Genève, 1826.

7. Organographie Végétale, ou Déscription raisonnée des plantes; 2 vols. 8vo. Paris, 1827. (This work has been translated into German by Meissner, in 1828.)

8. Collection de mémoires pour servir à l'histoire du Règne Végétal: 1°. Mémoire sur la famille de Mélastomacées; 2°. Mémoire sur la famille des Crassulacées: 2 vols. 4to. Paris, 1828.

9. Mémoire sur la famille des Ombellifères; 4to. Paris, 1829.

10. Mémoire sur la famille des Onagraires; 4to. Paris, 1829.

11. Mémoire sur la famille des Loranthacées; 4to. Paris, 1830.

12. Mémoire sur la famille des Valerianées; 4to. Paris, 1832.

13. Cours de Botanique; seconde partie. Physiologie Végétale pour servir de suite à l'Organographie Végétale, et d'introduction à la Botanique Géographique et Agricole; vol. i.—iii.; 8vo. Paris, 1832.

De Candolle was also the author of an essay on Geographical Botany, prefixed to the second volume of the 'Flore Française' (1805).—Of the article "Géographie botanique et agricole," in the 'Dictionnaire d'Agriculture,' published in 1809.—Of the article "Géographie botanique," in the 'Dictionnaire des Sciences Naturelles,' 1820.—And of the article "Phytographie," in the 'Dictionnaire classique d'histoire naturelle.'

geometricè consideratâ; seu de Maximis et Minimis pars prior elementaris, and in which he treats geometrically, and with singular elegance and vigour of demonstration, all the elementary problems relating to isoperimetric figures and solids. About the same time he presented to the Academy of Berlin a memoir, which was afterwards published in its Transactions, on the minima relating to the figure of the cells of bees, a subject which he appears, in that paper, to have exhausted.

The prize proposed by the same Academy in 1786, was adjudicated to him for a memoir, which was since published under the title of *Exposition élémentaire des principes des calculs supérieurs*. In this masterly essay the differential calculus is derived from a principle which D'Alembert had, in the first edition of the *Encyclopédie*, so happily illustrated, and which is now so generally recognised as the basis of that calculus; namely, the doctrine of limits.

On his return to Geneva in 1789, l'Huillier published an opuscle, which acquired great celebrity, entitled *La Polygonométrie; ou de la mesure des figures rectilignes, et abrégé d'isopérimétrie élémentaire, ou de la dépendance mutuelle des grandeurs et des limites des figures*; at the conclusion of which he gives a masterly summary of his former researches on elementary isoperimetry. In this work are given several formulæ of great generality, and which, at that time, were entirely new, and were calculated to facilitate the study of numerous relations arising from the perimeters and areas of polygons. About the same period, indeed, Mascheroni published formulæ very analogous to those of l'Huillier; but the latter afterwards succeeded in showing that he had arrived at the same results by original processes.

During the tempestuous years of the revolution, l'Huillier sought in Germany the retirement so necessary to his pursuits; and chose Tubingen as his residence. The fruit of his labours during this seclusion was a work almost wholly new, which appeared at Tubingen, in 1795, under the title *Principiorum calculi differentialis et integralis expositio elementaris*.

He was invited, about this time, to the chair of the Higher Mathematics in the University of Leyden; but his attachment to his native country was too deeply rooted to admit of his accepting this flattering offer: and eventually, in June of the same year (1795), he attained the object of his highest ambition, by receiving, after a successful public competition, the appointment of Professor of Mathematics in the Academy of Geneva.

At a subsequent period he was associated with his friend and colleague Professor Prévost in the composition of several memoirs on the calculation of probabilities, which appeared under their joint names in the memoirs of the Berlin Academy. The questions treated of in these memoirs, although they do not reach the higher problems belonging to this department of mathematics, are yet resolved by methods remarkable for their perspicuity and elegance. L'Huillier published, in 1804, his *Elémens raisonnés d'Algèbre, publiés à l'usage des étudians*; in 2 vols. 8vo, a work of considerable

merit, as developing with clearness the true principles by which the understanding advances from that which is known to that which is unknown.

His last work, the *Elémens d'Analyse Géométrique et Algébrique, appliquées à la recherche des lieux géométriques*, in 4to, appeared in the year 1809. It was dedicated to his former pupil, Prince Czartorynski, who was, at that time, minister of public instruction in the vast empire of Russia, but who has since become better known to Europe as the most illustrious of the exiled Poles.

The declining health of l'Huillier obliged him at length to resign a professorship which he had held during five-and-twenty years, and the duties of which he had ever discharged with the most undeviating regularity, and the most scrupulous exactness. Even while suffering acutely from a painful attack of sciatica, he insisted on being carried to his class, lest any detriment should arise to his pupils from an interruption to his lectures. Many of these pupils have subsequently distinguished themselves in their scientific career; among these may be cited one of our illustrious foreign members, Professor Sturm.

For the simplicity of his manners and the strict integrity of his character, l'Huillier was no less remarkable than for the vigour and extent of his mathematical powers: by these qualities he was endeared to his friends, and esteemed and respected by all, during a life protracted beyond the ordinary duration. His death occurred on the 28th of March, 1840, when he had nearly completed his 90th year, with a constitution, however, which had some time previously been shattered and broken down by the infirmities incident to so advanced an age*.

Félix Savart, a philosopher distinguished more especially for his researches in the science of Acoustics, was born on the 30th of June, 1791, at Mézières, the capital of the Department of the Ardennes, in France. He very early exhibited a decided turn for mechanical invention, and his greatest delight was to contrive and construct with his own hands musical instruments and apparatus illustrative of Natural Philosophy, a study of which he was passionately fond. His parents had been connected with the school of engineers at Mézières; and several of his relations having been distinguished as artists, he was himself educated with a view to the same destination. But the family afterwards removing to Metz, the path which had at first been marked out for him was abandoned, and he prepared himself for another profession, by directing his whole attention to medicine. In course of time he obtained the appointment of Assistant Surgeon in the Military Hospital. Not satisfied with this probation, he, in 1814, repaired to Strasburg for the purpose of prosecuting his medical studies in the Military

* The above account is derived from a biographical notice by Professor De La Rive, which forms part of the *Compte rendu de l'état de l'instruction publique de Genève pendant l'année scolaire*, 1839-1840.

Hospital of that town ; and he subsequently, in 1816, took a degree in medicine in the University. He then returned to his paternal roof at Metz, with the intention of settling, and of applying himself diligently to the practice of his profession. But on being restored to the scene of his youthful occupations, the renewed sight of those philosophical instruments to which so many delightful associations were attached, rekindled in full force the innate predilection for the physical sciences, which, during so long an interval, had lain dormant in his breast. The charms of science, arrayed in her most attractive colours, glittered before his imagination, and were contrasted, in his ardent mind, with the cares, the toils, and the anxieties of the profession in which he was embarking. He yielded to the powerful fascination, and disregarding all considerations of prudence, took the irrevocable step of abandoning the prospects which were opening in a career to which his youth had been devoted, and by which alone it had, till then, been his ambition to earn fortune, reputation and independence. Confiding in his knowledge of Acoustics, which was ever his favourite study, and in which he conceived he had made discoveries, he quitted his provincial domicile and repaired to the metropolis, as to the mart where his acquisitions would be best valued. He arrived in Paris with but scanty means of immediate support, without a friend, and unprovided with a single letter of recommendation. But Fortune took him by the hand, and favoured his first endeavour to obtain notice. He presented himself to Biot, and communicated to him his views, and the results of his researches in Acoustics. He met with the kindest reception from that philosopher, who had himself been occupied with similar inquiries, and was well qualified to appreciate the merits of Savart. Biot was ever after his friend and patron, and it was chiefly through his influence that Savart was, in the year 1820, appointed Professor of Natural Philosophy in one of the Institutions at Paris; an office which he continued to hold till the year 1827, when he was nominated a Member of the Academy of Sciences. Soon after this he was associated with Thénard, as Conservator of the Cabinet of Physics of the College of France. Thus raised to a state of independence, he had full leisure to devote himself to the science he had ever particularly cherished, and of which his labours have greatly extended the boundaries. His admirable researches on the laws of the vibrations of solid bodies of different forms and kinds, and in particular, of cords, of membranes, of rods, whether straight, or bent, or of an annular shape ; of flat discs, and of solids of revolution, both solid and hollow, have furnished results of great value and importance. His investigation of the structure and functions of the several parts of the vocal organs, and his theory of the voice, both in man and in the lower animals, show great originality of research, and have thrown considerable light on a very difficult department of Physiology.

Savart was elected, in the year 1839, a Foreign Member of the Royal Society, an honour which his unconquerable prejudice against the English, and everything emanating from England, prevented

his ever acknowledging. His premature death, on the 16th of March, 1840, has, unfortunately for science, arrested the brilliant career of discovery, which he was pursuing with so much ardour and success, and will, it is to be feared, deprive the world of the fruits of many of his unfinished labours*.

* The materials for the above sketch were furnished by the Funeral Oration on Savart pronounced before the Royal Academy of Sciences of the Institute of France, by M. Becquerel, on the 18th of March, 1841.

The following is a list of Memoirs by Félix Savart:—

1. Mémoire sur la construction des instrumens à cordes et à archet. (Paris, 1819.)
2. Mémoire sur la communication des mouvemens vibratoires entre les corps solides. (Annales de Chimie, tome xiv.)
3. Recherches sur les vibrations de l'air. (Ibid. t. xxiv.)
4. Mémoire sur les vibrations des corps solides considérées en général. (Ibid. t. xxv.)
5 Recherches sur les usages de la membrane du tympan et de l'oreille externe. (Ibid. t. xxvi.)
6. Nouvelles recherches sur les vibrations de l'air. (Ibid. t. xxix.)
7. Mémoire sur la voix humaine. (Ibid. t. xxx.)
8. De l'influence exercée par divers milieux sur le nombre de vibrations des corps solides. (Ibid. t. xxx.)
9. Note sur la communication des mouvemens vibratoires par les liquides. (Ibid. t. xxxi.)
10. Mémoire sur la voix des oiseaux. (Ibid. t. xxxii.)
11. Note sur les modes de division des corps en vibration. (Ibid. t. xxxii.)
12. Note sur les sons produits dans l'expérience de M. Clement. (Ibid. t. xxxv.)
13. Recherches sur les vibrations normales. (Ibid. t. xxxvi.)
14. Mémoire sur un mouvement de rotation dont le système de parties vibrantes de certains corps devient le siége. (Ibid. t. xxxvi.)
15. Sur la décomposition de l'ammoniaque par les métaux. (Ibid. t. xxxvii.)
16. Recherches sur l'élasticité des corps qui cristallisent régulièrement. (Ibid. t. xl.)
17. Recherches sur la structure des métaux. (Ibid. t. xli.)
18. Mémoire sur la réaction de torsion des lames et des verges rigides. (Ibid. t. xli.)
19. Note sur la sensibilité de l'organe de l'ouïe. (Ibid. t. xliv.)
20. Note sur la perception des sons graves. (Ibid. t. xlvii.)
21. Mémoire sur la constitution des veines liquides lancées par des orifices circulaires en minces parois. (Ibid. t. liii.)
22. Mémoire sur le choc d'une veine liquide lancée contre un plan circulaire. (Ibid. t. liv.)
23. Mémoire sur le choc de deux veines liquides animées de mouvemens directement opposés. (Ibid. t. lx.)
24. Recherches sur les vibrations longitudinales. (Ibid. t. lxv.)
25. Extrait d'un mémoire sur les modes de division des plaques vibrantes. (Ibid. t. lxxiii.)
26. Note sur les causes qui déterminent le degré d'élévation des sons. (Ibid. t. lxxv.)
27. Biot et Savart.—Sur la mesure de l'action exercée à distance sur une particule de magnétisme par un fil conjunctif. (Journal de Physique, t. xci.)

The thanks of the Meeting were given to Dr. Roget for having drawn up these biographical notices, which were ordered to be printed.

The Statutes relating to elections were then read.

Joseph Smith, Esq., and Richard Horsman Solly, Esq., were appointed Scrutators, to assist the Secretaries in examining the balloting lists.

The ballot was then taken, and Dr. Roget, on the part of the Scrutators, reported the following gentlemen as being duly elected Officers and Council for the ensuing year:—

President.—The Marquis of Northampton.

Treasurer.—Sir John William Lubbock, Bart., M.A.

Secretaries. { Peter Mark Roget, M.D.
Samuel Hunter Christie, Esq., M.A.

Foreign Secretary.—John Frederic Daniell, Esq.

Other Members of the Council.—Neil Arnott, M.D.; Francis Baily, Esq.; William Thomas Brande, Esq.; Richard Bright, M.D.; William Henry Fitton, M.D.; Sir William J. Hooker, K.H., LL.D.; William Hopkins, Esq., M.A.; William Lawrence, Esq.; Gideon Algernon Mantell, Esq., LL.D.; William H. Pepys, Esq.; The Rev. Baden Powell; George Rennie, Esq.; Lieut.-Col. William H. Sykes; Charles Wheatstone, Esq.; Rev. William Whewell, D.D.; Rev. Robert Willis, M.A.

The thanks of the Meeting were given to the Scrutators for their trouble in examining the lists.

The following is the statement of the Receipts and Payments of the Society during the preceding year, which was laid on the table by the Treasurer:—

Statement of the Receipts and Payments of the Royal Society between Nov. 28, 1840, *and Nov.* 28, 1841.

Receipts:—	£ s. d.		£ s. d.
Balance in the hands of the Treasurer at the last Audit ..			937 19 7
26 Weekly Contributions, at one shilling	67 12 0		
184 Quarterly Contributions at £1..........	748 0 0		
			815 12 0
40 Admission Fees			400 0 0
2 Compositions for Annual Payments at £40			80 0 0
6 Compositions for Annual Payments at £60...........			360 0 0
Rents:—			
One year's rent of estate at Mablethorpe: due at Michaelmas 1840	107 0 0		
One year's rent of lands at Acton: due at Michaelmas 1840	60 0 0		
One year's fee-farm rent of lands in Sussex; land-tax deducted: due at Michaelmas 1840	19 4 0		
Carried forward	186 4 0		2593 11 7

	£	s.	d.	£	s.	d.
Brought forward ...	186	4	0	2593	11	7
One-fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's will: due at Midsummer 1840	3	0	0			
				189	4	0
Dividends on Stock:—						
One year's dividend on £14,000 Reduced 3 per cent. Annuities	420	0	0			
Dividend on 3452*l.* 1*s.* 1*d.* Consols, the produce of the sale of the premises in Coleman-street........................	103	11	2			
One year's dividend on £200 Consols	6	0	0			
Donation Fund.						
One year's dividend on 4544*l.* 16*s.* 9*d.* Consols	136	6	10			
Rumford Fund.						
One year's dividend on 2292*l.* 11*s.* 7*d.* Consols	68	15	6			
Fairchild Fund.						
One year's dividend on £100 New South Sea Annuities	3	0	0			
				737	13	6
Miscellaneous Receipts:—						
Received of Dr. Knorr for the Royal Society's Pendulum				50	0	0
Sale of Philosophical Transactions, Abstracts of Papers, and Catalogues of the Royal Society's Library				299	15	8
Sale of Nine Scientific Catalogues to Subscribers				4	10	0
Total Receipts				£3874	14	9

Payments:—	£	s.	d.	£	s.	d.
Fairchild Lecture.—The Rev. J. J. Ellis, for delivering the Fairchild Lecture for 1840				3	0	0
Bakerian Lecture.—George Newport, Esq., for the Bakerian Lecture for 1841				4	0	0
Rumford Fund.—M. Biot: Two years' dividend on the Augmentation Fund, 1840............................				71	11	6
British Museum Fund.—						
Bailliere: for Books..................	33	0	6			
Stibbs: for ditto	5	0	0			
Carried forward ...	38	0	6	78	11	6

	£	s.	d.	£	s.	d.
Brought forward	38	0	6	78	11	6
British Museum Fund.—						
Weale: for Books	30	8	10			
Robinson: for ditto..................	15	2	0			
Crofts: for ditto	16	9	3			
Sundry, for ditto	1	18	6			
				101	19	1
Grubb:						
For two Magnetometers for the Norwegian Observatory	78	15	6			
Ditto, for two Magnetometers for the Cairo Observatory	76	0	0			
Troughton and Simms:						
For instruments for the Pacha of Egypt..	67	4	0			
Ditto ditto for the Hammerfest Observatory	9	3	0			
Robinson: for ditto..................	27	5	0			
				258	7	6*
Salaries:—						
Dr. Roget, one year, as Secretary	105	0	0			
S. H. Christie, Esq., one year, as Secretary..	105	0	0			
Ditto for Index to Phil. Trans.	5	5	0			
John F. Daniell, Esq., one year, as For. Sec.	20	0	0			
Mr. Roberton, one year, as Assistant-Secretary	200	0	0			
Mr. W. E. Shuckard, one year, as Librarian..	50	0	0			
Mr. Holtzer, one year, as Porter..........	30	0	0			
Ditto, for extra Porterage	10	0	0			
				525	5	0
Few, Hamilton and Few, Solicitors:						
Law Expenses				15	16	2
Ditto, for Mablethorpe Tithe Suit				10	3	8
Mablethorpe Tithe Suit:—Society's proportion of the Costs of defending the Suit				110	0	0
Ditto, for Rate.......................................				82	10	0
Fire Insurance, on the Society's Property				22	11	6
Mrs. Coppard: Gratuity.............................				10	0	0
Mr. Shuckard, for making Catalogue of Miscellaneous Books				54	0	0
Ditto, for rearranging the Library				150	0	0
Ditto, for completing Scientific Catalogue and Tracts				50	0	0
Mr. Tuckett: for assisting with same..................				29	8	0
Bills:—						
Taylor:						
Printing the Phil. Trans., 1840, part 2 ..	265	16	6			
Ditto, 1841, part 1.................	74	15	0			
Ditto, Proceedings, Nos. 45—48; Circulars, Lists of Fellows, Ballot-lists, Statement of Payments, and Minutes of Council; &c. &c.	124	16	6			
Carried forward ...	465	8	0	1498	12	5

* This amount will be repaid to the Society.

	£	s.	d.	£	s.	d.
Brought forward	465	8	0	1498	12	5
Taylor:						
Printing Supplemental Instructions for the Magnetic Observatories, &c.	6	1	6			
Ditto, Catalogue of Miscellaneous Books..	136	7	0			
Ditto, Catalogue of MS. Letters	137	9	6			
				745	6	0
Bowles and Gardiner:						
For Paper for the Phil. Trans., 1840, part 2, and 1841, part 1				165	0	0
Basire:						
For Engraving and Copper-plate Printing for Phil. Trans., 1841, part 1				181	2	10
Walker:						
For Plates for Phil. Trans. 1840, part 1, and for Plates for Scientific Report..............				25	7	2
Gyde:						
Boarding and Sewing 800 Parts of Phil. Trans., 1840, part 2	27	4	0			
Ditto, 1841, part 1..........	27	4	0			
Ditto, 1831, part 1 and 2, &c...........	1	18	8			
Boarding Catalogue of Miscellaneous Literature.........................	12	14	2			
Ditto, 400 Catalogues of MS. Letters....	7	10	0			
				76	10	10
Tuckett:						
Bookbinding	204	15	2			
Pouncey and Sons:						
For Stationery	8	2	10			
Saunderson:						
For Shipping Expenses	8	10	5			
Brecknell and Turner:						
Wax Lights, Candles, and Lamp Oil	39	16	0			
Cubitt:						
For Alterations in Library, Lower Library, and Council Room, and repairing and relaying Carpets, &c.	112	6	7			
Exchequer Fee for paying dividend	0	13	0			
Clerks: Christmas Fee................	1	1	0			
Arnold:						
For Coals	20	6	0			
Ditto (Porter's yearly allowance)	4	7	0			
Murray:						
For taking Meteorological Observations	7	0	0			
Smith, Elder, and Co.:						
Writing Circular Letter to the Pacha of Egypt	4	14	0			
Gwillim:						
Mats, Brushes, Fire-wood, &c.	4	1	10			
Carried forward ...	415	13	10	2691	19	3

				£	s.	d.
Brought forward ...	415	13	10	2691	19	3
Cardinal:						
For Turkey Carpet for Lower Library	23	18	9			
Black and Armstrong:						
For Carriage of Books from Rotterdam	4	0	0			
				443	12	7
Taxes and Parish Rates:						
Land and Assessed Taxes	26	9	5			
Poor Rate	15	11	8			
Church Rate	12	15	0			
Rector's Rate........................	1	8	4			
Sewer's Rate	2	2	6			
				58	6	11
Petty Charges:						
Postage and Carriage..................	10	14	7			
Expenses on Foreign Packets, &c.........	10	16	8			
Stamps	2	14	6			
Charwoman's Wages..................	27	6	0			
Ditto, Extra work	2	9	0			
Miscellaneous expenses	11	8	7			
Library and Window-cleaning, &c.	2	14	0			
Packer, for ingrossing Addresses..........	3	10	0			
				71	13	4
Total Payments				£3265	12	1
Total Receipts and Balance				3874	14	9
Balance in the hands of the Treasurer				£ 609	2	8

JOHN WILLIAM LUBBOCK, *Treasurer.*

November 29*th*, 1841.

The Balances in hand, now belonging to the several trusts, are as under: viz:—

	£	s.	d.
Donation Fund	260	16	10
Rumford Fund	140	17	0

The following table shows the progress and present state of the Society, with respect to the number of Fellows:—

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2 12*s*. Annually.	Paying £4 Annually.	Total.
November 1840....	12	49	537	25	189	812
Since elected......	......	......	6	......	33	39
Since re-instated ..	......	......	......	......	......	....
Since compounded	......	......	+2	......	−2	
Since deceased, &c.	......	−3	−15	......	−3	−21
Defaulters........	......	......	......	......	−3	−3
November 1841....	12	46	528	25	216	827

Weekly and Quarterly Contributions.

1830......................	£363	4	0
1831......................	286	0	0
1832......................	255	6	0
1833......................	283	7	6
1834......................	318	18	6
1835......................	346	12	6
1836......................	495	0	0
1837......................	531	0	0
1838......................	599	4	0
1839......................	666	16	0
1840......................	767	4	0
1841......................	815	12	0

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1841–42. No. 51.

December 9, 1841.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

The reading of minutes of the Anniversary Meeting occupied the whole of this Meeting.

December 16, 1841.

LIEUT.-COLONEL WM. HENRY SYKES, V.P., in the Chair.

John Joseph Bennett, Esq., was balloted for, and duly elected a Fellow of the Society.

Samuel Elliott Hoskins, M.D., was also balloted for, but was not elected a Fellow of the Society.

The following papers were read, viz.:—

"Papers from the several Magnetic Observatories established in India, addressed to the Secretary of the Royal Society, by direction of the Honourable East India Company." Communicated by P. M. Roget, M.D., Sec. R.S.

1. The Magnetic Observatory at Singapore.

Twenty-seven anemometer curves. Eight magnetic observations for February 1841. Anemometer curves for March, April and May 1841. Magnetic observations made on the term-days in November and December 1840, and January 1841, with an abstract of the magnetic and meteorological instruments, from the commencement of December 1840 to the end of January 1841.

Daily curves of certain magnetic instruments during the months of December 1840 and January 1841. Monthly curves for December 1840 and January 1841.

2. The Magnetic Observatory at Madras.

Term-day curves for the months of January, February, March, April, May and June 1841.

Monthly observations of the magnetical and meteorological instruments for August; also two absolute determinations of the horizontal intensity, taken in January and April 1841.

Monthly and term-day observations for May, June and July 1841.

Magnetic dip and intensity taken at Johanna, Madras and Singapore.

3. The Magnetic Observatory at Simla.

Magnetic and meteorological observations for January, February, March and April 1841; also transcripts of sheets D. for January, February and March 1841, to be substituted for similar sheets for those months.

Preliminary observations regarding the Magnetic Observatory at Simla for May 1841.

Observations for June 1841, including term-day curves; also a general abstract of the mean readings of the instruments.

Magnetic term observations for July and August 1841, made at the Magnetic Observatory, Simla.

4. "Variations de la déclinaison et intensité horizontale magnétique observées à Milan, pendant 24 heures de suite, le 28 et 27 Novembre 1841." Par Signor Carlini, For. Memb. R.S.

5. "On a Calculating Machine." By the Rev. Henry Moseley, M.A., F.R.S., Professor of Natural Philosophy and Astronomy in King's College.

The object which the author proposes to accomplish in the construction of this machine, is to determine mechanically the products, quotients, logarithms, squares, and other powers of the natural numbers, by means of combinations of greater simplicity than have hitherto been applied to the purposes of mechanical calculation. The paper is accompanied by a figure illustrating the principle of the machine, but not representing the mechanical details of its construction. An outline is then given of the essential parts of the instrument, and of the theory of their operation.

6. A paper was also in part read entitled, "On Fibre." By Martin Barry, M.D., F.R.SS. Lond. and Edin.

January 6, 1842.

LIEUT.-COLONEL WM. HENRY SYKES, V.P., in the Chair.

Lieut. Thomas John Newbold was balloted for, and duly elected a Fellow of the Society.

The reading of a paper entitled, "On Fibre," by Martin Barry, M.D., F.R.SS. Lond. and Edin., was resumed and concluded.

The author observes, that, in the mature blood-corpuscle, there is

often seen a flat filament, already formed within the corpuscle. In Mammalia, including Man, this filament is frequently annular; sometimes the ring is divided at a certain part, and sometimes one extremity overlaps the other. This is still more the case in Birds, Amphibia, and Fishes, in which the filament is of such length as to constitute a coil. This filament is formed of the discs contained within the blood-corpuscle. In Mammals, the discs entering into its formation are so few as to form a single ring; and hence the biconcave form of the corpuscle in this class, and the frequent annular form of the filament it produces. In the other Vertebrata, the discs contained within the blood-corpuscle are too numerous for a single ring; and they consequently form a coil. At the outer part of this coil, the filament, already stated to be flat, often presents its edge; whence there arises a greater thickness of the corpuscle, and an appearance of being cut off abruptly at this part; while in the centre there is generally found the unappropriated portion of a nucleus; and hence the central eminence, surrounded by a depression, in those corpuscles which, from the above-mentioned cause, have the edge thickened. The nucleus of the blood-corpuscle in some instances resembles a ball of twine; being actually composed, at its outer part, of a coiled filament. In such of the invertebrata as the author has examined, the blood-corpuscle is likewise seen passing into a coil.

The filament, thus formed within the blood-corpuscle, has a remarkable structure; for it is not only flat, but deeply grooved on both surfaces, and consequently thinner in the middle than at the edges, which are rounded; so that the filament, when seen edgewise, appears at first sight to consist of segments. The line separating the apparent segments from one another is, however, not directly transverse, but oblique.

Portions of the clot in blood sometimes consist of filaments having a structure identical with that of the filament formed within the blood-corpuscle. The ring formed in the blood-corpuscle of Man, and the coil formed in that of Birds and Reptiles, have been seen by the author unwinding themselves into the straight and often parallel filaments of the clot; changes which may be also seen occurring in blood placed under the microscope before its coagulation; and similar coils may be perceived scattered over the field of view, the coils here also appearing to be altered blood-corpuscles, in the act of unwinding themselves; filaments, having the same structure as the foregoing, are to be met with apparently in every tissue of the body. The author enumerates a great variety of organs in which he has observed the same kind of filaments.

Among vegetable structures, he subjected to microscopic examination the root, stem, leaf-stalk, and leaf, besides the several parts of the flower: and in no instance of phanerogamous plants, where a fibrous tissue exists, did he fail to find filaments of the same kind. On subsequently examining portions indiscriminately taken from ferns, mosses, fungi, lichens, and several of the marine algæ, he met with an equally general distribution of the same kind of filaments. The flat filament seen by the author in all these structures, of both ani-

mals and plants, he states to be that usually denominated a *fibre*. Its appearance is precisely such as that of the filament formed within the corpuscle of the blood. It is known, he remarks, that discoid corpuscles circulate in plants; and it remains to be seen whether or not filaments are formed also in these.

By gradually tracing the fibre or filament above-mentioned into similar objects of larger size, the author endeavours to show that it is not possible to draw a line of separation between the minutest filament, and an object being to all appearance composed of two spirals running in opposite directions, and interlacing at certain regular intervals; an arrangement which produces in the entire object a flattened form, and gives it a grooved appearance. It is, in fact, the structure which, for want of a better term, he has called a *flat filament*. The edge of this filament presents what, at first sight, seem like segments, but which, in reality, are the consecutive curves of a spiral thread. A transverse section of such an object is rudely represented by the figure 8. This is also precisely the appearance presented by the minutest filament, generally termed *Fibre*: and the author particularly refers to the oblique direction of the line separating the apparent segments in the smaller filament, in connexion with the oblique direction of the spaces between the curves of the spiral threads in the larger one.

The spiral form, which has heretofore seemed wanting, or nearly so, in animal tissues, is then shown to be as general in animals as in plants. Nervous tissue, muscle, minute blood-vessels, and the crystalline lens, afford instances in proof of this. And if the author's view of identity in structure between the larger and the smaller filaments be correct, it follows that spirals are much more general in plants themselves than has been hitherto supposed; spirals would thus appear, in fact, to be as universal as a fibrous structure.

The tendency to the spiral form manifests itself very early. Of this the most important instance is afforded by the corpuscle of the blood, as above described. The author has also obtained an interesting proof of it in cartilage from the ear of a rabbit; where the nucleus, lying loose in its cell, resembled a ball of twine, being composed at its outer part of a coiled filament, which it was giving off to weave the cell-wall;—this cell-wall being no other than the last-formed portion of what is termed the intercellular substance—the essential part of cartilage. These nuclei in cartilage, as well as those in other tissues, there is ground for believing to be descended, by fissiparous generation, from the nuclei of blood-corpuscles.

The author then describes the mode of origin of the flat filament or fibre, and its reproduction in various animal and vegetable tissues, which he enumerates. He conceives that each filament is a compound body which enlarges, and, from analogy, may contain the elements of future structures, formed by division and subdivision, to which no limits can be assigned.

He then traces the formation of muscle out of cells, which, according to his observations, are derived from corpuscles of the blood, to the state where there exists what is denominated the *fibril*. In

this process, there are to be observed the formation of a second order of tubes within the original tube; a peculiarly regular arrangement of discs within these second tubes; the formation, first of rings and then of spirals, out of discs so arranged; the interlacing of the spirals; and the origin, in the space circumscribed by these, of spirals having a minuter size; which in their turn surround others still more minute; and so on. The outer spirals enter for the most part into the formation of the investing membrane discovered by Schwann, but for the only complete description of which, in a formed state, we are indebted to Mr. Bowman. The inner spirals constitute what are denominated the *fibrillæ*. The fibril appears to the author to be no other than a state of the object which he designates a *flat filament*; and which, as he shows, is a compound structure. The fibril he finds to be, not round and beaded, as it has been supposed, but a flat and grooved filament; the description above given of the structure of the filament being especially applicable here. This flat filament is so situated in the fasciculus of voluntary muscle, as to present its edge to the observer. It seems to have been the appearance presented by the edge of this filament, that is to say, by the curves of a spiral thread, that suggested the idea of longitudinal bead-like enlargements of the fibril, as producing striæ in the fasciculus of voluntary muscle. In the author's opinion, the dark longitudinal striæ are spaces (probably occupied by a lubricating fluid) between the edges of flat filaments, each filament being composed of two spiral threads, and the dark transverse striæ, rows of spaces between the curves of these spiral threads. The filament now mentioned, or its edge, seems to correspond to the *primitive marked thread* or *cylinder* of Fontana—to the *primitive fibre* of Valentin and Schwann—to the *marked filament* of Skey—to the *elementary fibre* of Mandl—to the *beaded fibril* of Schwann, Müller, Lauth, and Bowman—and to the *granular fibre* of Gerber. The changes known to be produced by the alternate shortening and lengthening of a single spiral are exhibited in the microscope by a fasciculus of spirals, not only in its length and thickness, but in the width of the spaces (*striæ*) between the curves of the spirals. And a muscle being no other than a vast bundle of spirals, it is in contraction short and thick; while in relaxation it is long and thin; and thus there occurs no flattening of bead-like segments in contraction. The author has found no segments that could undergo this change. These observations on the form of the ultimate threads in voluntary muscle, were first made on the larva of a Batrachian reptile; and have been confirmed by an examination of this structure in each class of vertebrated animals, as well as in the Crustacea, Mollusca, Annelida, and Insects.

He finds that the toothed fibre, discovered by Sir David Brewster in the crystalline lens, is formed out of an enlarged filament; the projecting portions of the spiral threads in the filament, that is, the apparent segments, becoming the teeth of that fibre.

The compound filaments are seen with peculiar distinctness in the blood-vessels of the arachnoid membrane. In connexion with the spiral direction of the outer filament in these vessels, the author refers

to the rouleaux in which the red blood-discs are seen to arrange themselves, in the microscope, as probably indicating a tendency to produce spiral filaments. To form rouleaux, corpuscle joins itself to corpuscle, that is to say, ring to ring; and rings pass into coils. The union of such coils, end to end, would form a spiral. But the formation by the blood-corpuscles of these rouleaux is interesting in connexion with some facts recorded by the author in a former memoir; namely, that many structures, including blood-vessels, have their origin in rows of cells derived from corpuscles of the blood. The human spermatozoon presented a disc with a pellucid depression, each of the two sides of the peripheral portion of which was extended into a thread; these two threads forming by being twisted the part usually designated as the tail. The occurrence of two tails, observed by Wagner, is accounted for by the author by the untwisting of these threads.

The author has noticed very curious resemblances in mould, arising from the decay of organic matter, to early stages in the formation of the most elaborate animal tissues, more particularly nerve and muscle. Flax has afforded satisfactory evidence of identity, not only in structure, but in the mode of reproduction, between animal and vegetable fibre.

Valentin had previously stated that in plants all secondary deposits take place in spiral lines. In the internal structure of animals, spirals have herotofore seemed to be wanting, or very nearly so. Should the facts recorded in this memoir, however, be established by the researches of other investigators, the author thinks the question in future may perhaps be, where is the "secondary deposit" in animal structure, which is not connected with the spiral form? The spiral in animals, as he conceives he has shown, is in strictness not a secondary formation, but the most primary of all; and the question now is, whether it is not precisely so in plants.

In a postscript the author observes, that there are states of voluntary muscle in which the longitudinal filaments ("fibrillæ") have no concern in the production of the transverse striæ; these striæ being occasioned by the windings of spirals, within which very minute bundles of longitudinal filaments are contained and have their origin. The spirals are interlaced. When mature, they are flat and grooved filaments, having the compound structure above described. With the shortening of the longitudinal filaments ("fibrillæ") in muscular contraction, the surrounding spirals, and of course the striæ, become elongated and narrow; while in relaxation these changes are reversed.

January 13, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

Edward Hodges Baily, Esq., R.A., William Fishburn Donkin,

Esq., M.A., and Charles James Buchanan Riddell, Esq., Lieut. in the Royal Artillery, were balloted for, and severally elected Fellows of the Society.

A paper was in part read, entitled, "Researches in Physical Geology:" Third Series. By William Hopkins, Esq., M.A., F.R.S.

January 20, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

His Majesty the King of Prussia was balloted for, and duly elected a Fellow of the Society.

John Tricker Conquest, M.D., and Francis Henry Ramsbotham, M.D., were severally balloted for, but not elected into the Society.

1. The reading of a paper, entitled, "Researches in Physical Geology:" Third Series. By William Hopkins, Esq., M.A., F.R.S., was resumed and concluded.

In a paper formerly read to the Society, the author had investigated an analytical expression for the precession of the pole of the earth, on the hypothesis of the earth's being composed of a heterogeneous solid shell inclosing a heterogeneous fluid; and showed that its amount, deduced from that hypothesis, could not agree with its actual observed amount, unless the ellipticity of the interior surface of the shell were less by a certain quantity than that of the exterior surface. As the ellipticity of the inner surface (assuming always that the earth was originally fluid) depends on the thickness of the shell, the author, in the present paper, determines the least thickness which can be deemed compatible with the observed amount of precession.

In his former communication, the author had contemplated only the case in which the transition from the solidity of the shell to the fluidity of the mass contained in it was immediate; but in the case of the earth it must be gradual and continuous. It is remarked, however, that if in the actual case we were to consider all that portion of the mass as solid which is not perfectly fluid, we should take the thickness of the shell too great; and, on the other hand, if we were to consider the whole of that as perfectly fluid which is not perfectly solid, we should take the thickness of the shell too small. There must, consequently, be some surface of equal fluidity, (or, if we please, of equal solidity,) such that if all above it were perfectly solid, and all beneath it perfectly fluid, the precession would be the same as in the case in which the transition from the solidity of the shell to the fluidity of the interior mass is continuous. This surface is termed by the author the *effective inner surface*; and the distance

between this surface and the outer one, the *effective thickness* of the shell.

The degree of solidity or fluidity at any point in the interior of the earth must depend partly on the temperature at that point, and may also depend partly on the pressure there. Both causes are here assumed to be effective: if the latter be not so, it will easily be seen that the conclusion arrived at will, *à fortiori*, be true.

If through any point in the interior of the earth, (as, for instance, a point in the axis of rotation,) we take a surface of equal temperature, and through the same point, a surface of equal pressure, it is evident that the surface of equal fluidity (or solidity) through that point must be intermediate to these two surfaces. Its exact position cannot be determined without an experimental knowledge, which we do not possess, of the relative effects of temperature in opposing, and of pressure in promoting the process of solidification. It is sufficient, however, for the purpose now in view, to know that it must necessarily lie between the surfaces of equal temperature and of equal pressure as its extreme limits; and of these the author proceeds to determine the position.

The forms of the isothermal surfaces within a spheroid have never been completely determined. The determination given by the author is an extremely approximate one when the ellipticity is small, and the time during which the process of cooling has been going on is very great, as it is presumed to be in the case of the earth.

The author then enters into the analytical investigation of this problem; and deduces the conclusion that we must descend to a depth greater than about one-fifth of the earth's radius before we arrive at a surface of equal fluidity (or solidity) having an ellipticity of the requisite value: that is, the effective thickness of the crust must be at least equal to one-fourth or one-fifth of the earth's radius, in order that the precession may have its observed value: a conclusion, the author observes, which entirely removes the foundation of certain vague and somewhat fanciful speculations in geology, proceeding on the hypothesis of the thickness of the earth's crust not being greater than twenty or thirty miles. It has been imagined that in active volcanos, the volcanic vent may communicate directly with the central fluid nucleus, whence the ejected fluid mass has been supposed to be derived. This notion, the author conceives, is rendered totally inadmissible, when it is proved that the thickness of the solid portion of the globe cannot be less than 800 or 1000 miles. It is also remarked, that it follows from the great thickness of the crust, that the present interior temperature of the earth cannot be due to its original heat unless pressure be effective in promoting solidification, a fact not yet established by experiment: for, if the present temperature be due to that cause, it is certain that it must be sufficient at the depth of probably less than fifty miles to reduce the matter composing the crust of the globe to a state of fusion under the atmospheric pressure; whereas it has been proved that the earth is solid to a very much greater depth; which can be account-

ed for, therefore, only by supposing its solidity to be preserved by the enormous pressure to which, at considerable depths, the mass is subjected. The author then offers an explanation of the phenomena of volcanos on the supposition that a portion of matter more fusible than the general mass of the globe exists in a state of fusion in subterranean reservoirs, forming so many subterranean lakes of determinate extent; in some cases originally distinct; in others, communicating with adjoining lakes, by more or less obstructed channels; a theory which will also account for all the obscure geological elevations, except perhaps the earliest, as being produced by a simultaneous action of a fluid pressure on every portion of the lower part of a solid mass of definite extent. The author considers this harmony in his general views with the results of analytical investigation as constituting for them a strong claim to the attention of geologists.

Another important conclusion which the author deduced from his researches is, that if the interior temperature of the earth be due to its primitive heat, pressure must be effective in promoting solidification of masses at high temperatures.

2. The following paper was read:—"Contributions to Terrestrial Magnetism," No. III. By Lieut.-Colonel Edward Sabine, R.A., F.R.S.

In this memoir, the author gives a detailed account of the observations on the magnetic intensity made at sea by the officers of the Erebus and the Terror on their passage from England to Kerguelen's Land; the unreduced observations transmitted to the Admiralty by the Commanders of these ships, Captain James Ross and Captain Crozier, having been placed in his hands for that purpose.

The first part of the paper relates to the observations made between England and the Cape of Good Hope; and the second, to those made between the Cape and Kerguelen's Land. These observations, made at various stations, are given in the form of tables; and their accordance with the isodynamic lines drawn from Mr. Dunlop's observations, contained in the first number of the author's contributions on this subject, is pointed out.

January 27, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

Samuel Peace Pratt, Esq., was balloted for, and duly elected a Fellow of the Society.

The following papers were read, viz.—

1. "Barometrical Observations made at Yarmouth, Norfolk, on

the 21st of June and 21st of September 1841." By Arthur Utting, Esq. Communicated by Captain Edward J. Johnson, R.N., F.R.S.

2. "On the Anatomy and Physiology of the Decidua." By Robert Lee, M.D., F.R.S.

In this paper, the author describes some appearances which he has observed in the structure of the human decidua, and which apparently prove that the circulation of the maternal blood in the ovum is carried on during the early months of gestation, chiefly by the different layers of this membrane, and the cells of the chorion. He has been led by his observations to the belief, that the veins of the uterine decidua convey blood from the decidual cavity into the veins of the uterus; and that, in all probability, a current of maternal blood is constantly flowing from the cells of the chorion, through the decidua reflexa, into the decidual cavity.

February 1, 1842.

At a Special Meeting of the Royal Society, held at nine o'clock, A.M.,

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

His Majesty the King of Prussia came to the Society, accompanied by Baron Alexander von Humboldt: whereupon the Vice-President in the Chair addressed him in the following words:—

"May it please Your Majesty,

"It is my duty to express to Your Majesty the great regret which we feel, and which we are confident that the Marquis of Northampton the President of this Society will participate in, that, being in a distant country, he is unable to be present upon this auspicious occasion, so interesting to the members, and which will long be gratefully remembered in the history of the Society.

"In his absence, therefore, I must endeavour, however imperfectly, to express to Your Majesty, the great gratification with which the Society will see the august name of Your Majesty, who is venerated as the encourager of art, of literature, and of science, enrolled in our Charter book in the same page with those of our most gracious and beloved Sovereign and her illustrious Consort; and we beg leave accordingly to present the Charter book to Your Majesty for that purpose."

His Majesty then signed his name in the Charter book, and was duly admitted a Fellow of the Society.

His Majesty expressed his gratification at having his name enrolled among the Fellows of the Royal Society.

Baron Alexander von Humboldt, formerly elected a Foreign Member, also signed his name in the Charter book, and was duly admitted a Fellow.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 52.

February 3, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

The following papers were read, viz.—

1. "Abstracts of the Magnetic Term-day Observations for June, July, August, and September 1841," from the Honourable East India Company's Magnetic Observatory at Singapore.

2. "Graphical representations of the Term-day Observations from April to September inclusive, 1841," from the same Observatory.

3. "Abstracts of the Daily Magnetic and Meteorological Observations for September 1841," made at the Honourable East India Company's Magnetic Observatory at Madras.

4. "Abstracts of the Daily Magnetic and Meteorological Observations for September 1841," made at the Honourable East India Company's Magnetic Observatory at Simla.

The above were presented by the Honourable Court of Directors of the East India Company. Communicated by the Council of the Royal Society.

5. "Variations de la déclinaison et intensité horizontale magnétique observée à Milan, pendant 24 heures de suite, le 22 et 23 Décembre 1841, et le 19 et 21 Janvier 1842." Par Signor F. Carlini, For. Memb. R.S.

6. "A Meteorological Journal for 1841, kept at Allenheads, Northumberland, 1400 feet above the level of the sea, with an Appendix." By the Rev. W. Walton, M.A., F.R.S.

7. "Description of an Observatory constructed at Ardwick, and specification of the work performed in its erection." By John Jesse, Esq., at Ardwick. Communicated by Philip Hardwick, Esq., F.R.S.

8. "On the Steam-wave." By the Rev. Thomas Boys. Communicated by Charles Babbage, Esq, F.R.S.

The term *steam-wave* is employed by the author to denote that peculiar kind of wave which is generated during the motion of steam vessels on the water; and which he shows results from the combination of two separate sets of waves; namely, those occasioned simply by the progressive advance of the vessel, and which consequently recede from it on each side, nearly at right angles to its course; and those arising from the impulses given to the water by the action of the paddles, and proceeding in the same direction as the vessel itself. He ascribes to the cumulative force acquired by these waves at the parts where they cross one another, the extraordinary violence of effect with which they strike against all obstacles opposed to their progress, and which renders them so formidable to boats and other small vessels exposed to the encounter.

The Vice-President in the Chair stated, that he was directed by the Council to call the attention of the Members present, and through them of any philosophical inquirer who might at present be engaged in the prosecution of experimental research, to the existence of a fund at the disposal of the President and Council of the Society, denominated the *Donation Fund,* of which the dividends are to be applied, "from time to time, in promoting Experimental Researches, or in rewarding those by whom such researches may have been made, or in such other manner as shall appear to the President and Council for the time being most conducive to the interests of the Society in particular, or of science in general;" their application to extend to individuals of every country not being at the time Members of the Council;" and such dividends not to be hoarded parsimoniously, but be "expended liberally, and, as nearly as may be, annually, in furtherance of the declared objects of the Trust."

The fund was instituted by the late Dr. Wollaston, who contributed £2000 three per cent. Consols, and it received the following additions:—from the late Mr. Davies Gilbert, £1000 three per cent. Consols; from Mr. Warburton, £105; from Mr. Charles Hatchett, £105; from Mr. Guillemard, £100; and from the late Sir Francis Chantrey, £105.

The Vice-President in the Chair farther stated, that the dividends in the present year would amount to £140 16*s*. 6*d*.

Mr. W. Archibald Armstrong White, F.R.S., present at this meeting, gave £10 to the Donation Fund.

February 10, 1842.

LIEUT.-COLONEL WM. HENRY SYKES, V.P., in the Chair.

Thomas Glanville Taylor, Esq., was balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Magnetic-term Observations of the Declination, Inclination, and total Intensity, made at the Magnetic Observatory at Prague." By C. Kreil, Director of the Prague Observatory. Communicated by S. Hunter Christie, Esq., Sec. R.S.

2. "On the Chemical Analysis of the contents of the Thoracic Duct in the Human Subject." By George Owen Rees, M.D., Physician to the Northern Dispensary. Communicated by P. M. Roget, M.D., Sec. R.S.

The author, availing himself of a favourable opportunity which presented itself of examining the contents of the thoracic duct in a human subject, procured an hour and a quarter after death by hanging, to the amount of six fluid drachms, obtained by analysis the following result:—

Water, per cent.	90·48
Albumen, with traces of fibrinous matter	7·08
Aqueous extractive, or Zomodine	2·56
Alcoholic extractive, or Osmazome	0·52
Alkaline chloride, carbonate and sulphate, with traces of phosphate, and oxide of iron	0·44
Fatty matters	0·92
	100·

The fatty matters possessed the same general characters as those of the blood, except that they did not contain phosphorus, as appeared from their yielding an alkaline, instead of an acid ash by incineration. The aqueous extractive differed from that of the blood by giving a ferruginous ash. The salts obtained by incineration from the alcoholic extractive yielded a larger proportion of alkaline carbonate than those of the blood. The author is confirmed, by the experiments he made on the present occasion, in his former views concerning the cause of the white colour of the chyle, which he ascribes to the presence of opake white salivary matter as one of its constituents. The author then gives the results of his microscopical examination of the globules of the chyle, which he finds differ totally from those of the blood. He points out as being remarkable the large quantity of fatty matter existing in the chyle, and constituting an hydrocarbonaceous ingredient, which is constantly being added to the mass of blood, and is very rapidly consumed; as appears from the small quantity of this matter discoverable in the blood itself. The proportional quantity of osmazome in the chyle he finds greatly to exceed that contained in the blood.

February 17, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

Robert Edwards Broughton, Esq., was balloted for, and duly elected into the Society.

A paper was in part read, entitled, "On the Structure and Use of the Malpighian bodies of the Kidney, with Observations on the Circulation through that Gland." By William Bowman, Esq., F.R.S., Demonstrator of Anatomy in King's College, London, and Assistant Surgeon to the King's College Hospital.

February 24, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

The ballot for Major-General W. Morison, C.B., and Captain Owen Stanley, R.N., was deferred until the next meeting of the Society, there not being a sufficient number of Fellows present.

The following Meteorological Observations, taken in conformity with the Report drawn up by the Committee of Physics, including Meteorology, for the guidance of the Antarctic Expedition, as also for the various fixed Magnetic Observatories, have been communicated by the Lords Commissioners of the Admiralty and the Master-General of the Ordnance, viz.—

1. "Meteorological Observations taken on board Her Majesty's ship Erebus, for November and December 1840; and for January, February, March, April, May, June and July 1841." By Captain James Clark Ross, R.N., F.R.S., Commander of the Expedition. (*Forms* 1 & 2.)

2. "Meteorological Observations taken on board Her Majesty's ship Terror, for October, November and December 1840; and for January, February, March, April, May and June 1841." By Capt. T. B. M. Crozier, R.N. (*Forms* 1 & 2.)

3. "Meteorological Observations taken at the Magnetic Observatory, Cape of Good Hope, for February, March, April, May, June, July, August and September 1841." By F. Eardley Wilmot, Esq., Lieut. in the Royal Artillery. (*Forms* 1 & 2.)

4. "Meteorological Observations taken at the Magnetic Obser-

vatory, Ross-Bank, Van Diemen's Land, for April, May and June 1841." (*Forms* 1 & 2.)

5. The reading of a paper, entitled, "On the Structure and Use of the Malpighian bodies of the Kidney, with Observations on the Circulation through that Gland." By William Bowman, Esq., F.R.S., Demonstrator of Anatomy in King's College, London, and Assistant Surgeon to the King's College Hospital, was resumed and concluded.

The author describes the results of his examination of the structure and connexions of the Malpighian bodies of the kidney in different tribes of Vertebrata, and shows that they consist essentially of a small mass of vessels, contained within dilated extremities of the convoluted uriniferous tubes. The tubes themselves consist of an outer transparent membrane (termed by the author the *basement membrane*) lined by epithelium. This basement membrane, where it is expanded over the tuft of vessels, constitutes the capsule described by Müller. The epithelium lining the uriniferous tube is altered in its character where the tube is continuous with the capsule, being there more transparent, and furnished with cilia, which, in the frog, may be seen, for many hours after death, in very active motion, directing a current down the tube. Farther within the capsule the epithelium is excessively delicate, and even, in many cases, absent. The renal artery, with the exception of a few branches given off to the capsule, surrounding fat, and coats of the larger blood-vessels, divides itself into minute twigs, which are the afferent vessels of the Malpighian tufts. After it has pierced the capsule, the twig dilates, and suddenly divides and subdivides itself into several minute branches, terminating in convoluted capillaries, which are collected in the form of a ball; and from the interior of the ball the solitary efferent vessel emerges, passing out of the capsule by the side of the single afferent vessel. This ball lies loose and bare in the capsule, being attached to it only by its afferent and efferent vessel; and is divided into as many lobes as there are primary subdivisions of the afferent vessel; and every vessel composing it is bare and uncovered, an arrangement of which the economy presents no other example. The efferent vessels, on leaving the Malpighian bodies, enter separately the plexus of capillaries surrounding the uriniferous tubes, and supply that plexus with blood. The blood of the vasa vasorum also probably enters this plexus. The plexus itself lies on the outside of the tubes, on the deep surface of the membrane which furnishes the secretion; and from it the renal vein arises by numerous radicles.

Thus the blood, in its course through the kidney, passes through two distinct systems of capillary vessels; first, through that within the extremities of the uriniferous tubes; and secondly, through that on the exterior of these tubes. The author points out striking differences between these two systems. He also describes collectively

under the name of ***Portal System of the Kidney***, all the solitary efferent vessels of the Malpighian bodies, and compares them with the portal system of the liver; both serving to convey blood between two capillary systems. In the latter, a trunk is formed merely for the convenience of transport, the two systems it connects being far apart. But a portion even of this has no venous trunk, viz. that furnished by the capillaries of the hepatic artery throughout the liver, which pour themselves either into the terminal branches of the portal vein, or else directly into the portal-hepatic capillary plexus. On the other hand, in the kidney, the efferent vessels of the Malpighian bodies, situated near the medullary cones, having to supply the plexus of the cones, which is at some little distance, are often large, and divide themselves after the manner of an artery. They are portal veins in miniature. In further confirmation of his view of the existence of a true portal system in the kidney of the higher orders of animals, where it has never hitherto been suspected, the author describes his observations on the circulation through the kidney of the Boa Constrictor, an animal which affords a good example of those in which portal blood derived from the hinder part of the body traverses the kidney. He shows that here the Malpighian bodies are supplied, as elsewhere, by the artery, and that their efferent vessels are radicles of the vena portæ within the organ, and join its branches as they are dividing to form the plexus surrounding the tubes; thus corresponding with the hepatic origin of the great vena portæ. In other words, the vena portæ is an appendage to the efferent vessels of the Malpighian bodies, and aids them in supplying blood to the plexus of the tubes. Thus in this variety of the kidney, as in the liver, there is an internal as well as an external origin of the portal system; while in the kidney of the higher animals, this system has only an internal or renal origin, viz. that from the Malpighian bodies.

A detail of the results of injection by the arteries, veins and ducts is then given, and they are shown to accord with the preceding description. Many varieties in the Malpighian bodies in different animals are also pointed out, especially as regards their size.

The author then proceeds to found on his previous observations, and on other grounds, a theory of a double function of the kidney. He conceives that the aqueous portion of the secretion is furnished by the Malpighian bodies, and its characteristic proximate principles by the walls of the tubes. After giving in detail his reasons for entertaining this view, he concludes by referring to the striking analogy between the liver and kidney both in structure and function, and by expressing his belief, first, that diuretic medicines act specially on the Malpighian bodies, and that many substances, especially salts, which when taken into the system have a tendency to pass off by the kidneys with rapidity, in reality escape through the Malpighian bodies; secondly, that certain morbid products occasionally found in the urine, such as sugar, albumen, and the red particles of the blood, also, in all probability, pass off through this baro system of capillaries.

This paper is illustrated by numerous drawings from injected and recent specimens.

March 3, 1842.

FRANCIS BAILY, Esq., V.P., in the Chair.

Major-General W. Morison, C.B., and Captain Owen Stanley, R.N., were balloted for, and severally elected into the Society.

A paper was read, entitled, " On the Diurnal Temperature of the Earth's Surface, and the discussion of a simple Formula for ascertaining the same." By S. A. Drach, Esq. Communicated by John Lee, Esq., LL.D., F.R.S.

The author observes, in his introductory remarks, that during a period of twenty-four hours the quantity of calorific rays emitted from the sun, and falling on the exposed atmosphere of the earth, is proportional to one day's area as swept by the radius vector divided by the square of that radius; or is proportional to the true angular motion for that day; which is equivalent to substituting the declinations resulting from the true longitudes for those deduced from the mean ones at mean noons. On the arrival of the rays at the superior limit of our atmosphere, they undergo refraction, absorption, and difficulty of conduction; and when arrived at the surface of the earth, they suffer radiation and reflection; the absorption alone, at a vertical distance, amounting to upwards of one-fourth. The maximum sensible heat, he procceds to observe, appears to follow the sun in its diurnal revolution, being similar, in this respect, to the point of maximum tidal height of the ocean; hence he applies the term *thermal establishment* to the retardation of the effects caused by atmospherical conduction and localities, in the same manner that the term *tidal establishment* has been employed to denote the local constant by which the astronomical effects on the tides are delayed.

The tables annexed to the paper assume that the degree of the thermometer is proportional to the cosine of the sun's meridian altitude, commencing with that on the day of observation, and ending with the altitude thirty days previously. After explaining the formation of these tables, and detailing the conclusions derivable from them, the author gives a sketch of the perturbing causes, such as oceanic evaporation, mountain ranges, and other local influences; he then enters into a discussion of the mathematical expression for the daily heat; and he concludes with some observations on the theories of temperature and isothermal lines, as affected by the electrical and magnetical conditions of the earth, dependent on its rotation on its axis.

March 10, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas. in the Chair.

Cuthbert William Johnson, Esq., and Joseph Toynbee, Esq., were balloted for, and severally elected into the Society.

The following papers were read, viz.—

1. "Meteorological Observations, taken in conformity with the Report drawn up by the Committee of Physics, including Meteorology, for the guidance of the Antarctic Expedition; as also for the fixed Magnetic Observatories, at the Magnetic Observatory, Ross-Bank, Van Diemen's Land, for July and August 1841." Communicated by the Master-General of the Ordnance.

2. "Meteorological Register kept at Port Arthur, Van Diemen's Land, during the Year 1839." By Deputy Assistant Commissary-General Lempriere. Communicated by Captain Beaufort, R.N., F.R.S.

3. A paper was in part read, entitled, "Contributions to the Chemical History of the Compounds of Palladium and Platinum." By Robert Kane, M.D., M.R.I.A. Communicated by Francis Baily, Esq., V.P.R.S.

The Vice-President in the Chair announced that the Council had determined to propose to the Society the ejection of Mr. William John Bankes, F.R.S.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 53.

March 17, 1842.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas., in the Chair.

The reading of a paper, entitled "Contributions to the Chemical History of the Compounds of Palladium and Platinum." By Robert Kane, M.D., M.R.I.A., communicated by Francis Baily, Esq., V.P.R.S., was resumed and concluded.

The author states it to be his object, in this and in some subsequent papers, to examine specially the composition and properties of the compounds of palladium, platinum, and gold; and to ascertain how far they agree, and in what they differ, as to the laws of combination to which these compounds are subjected. He commences with the investigation of the compounds of palladium, employing for that purpose a portion of that metal with which he was furnished by the Royal Society out of the quantity bequeathed to the Society by the late Dr. Wollaston. He describes the mode of obtaining the protoxide of palladium, and enters into the analysis of the hydrated oxide, the black suboxide, and the true basic carbonate of that metal; detailing their properties and the formulæ which express their mode of composition. The chlorides of palladium form the next subject of inquiry; and the author concludes from his experiments that the loss of chlorine which the protochloride undergoes, when kept for some time in a state of fusion at a red heat, is perfectly definite; and also that the loss represents one half of the chlorine which the salt contains. But in the double salts formed by the protochloride of palladium with the chlorides of the alkaline metals, he finds that the similarity of constitution usually occurring between the compounds of ammonium and potassium is violated. From his analysis of the oxychloride of palladium the author concludes that it is quite analogous to the ordinary oxychloride of copper. He then examines a variety of products derived from the action of a solution of caustic potash on solutions of ammonia-chlorides of potassium. Their properties he finds to indicate analogies between palladium and other metals, whose laws of combination are better known. The sulphate, the ammonia-sulphates, the nitrates, and the ammonia-ni-

trates of palladium, and lastly, the double oxalate of palladium and ammonium, are, in like manner, subjected to examination in a detailed series of experiments.

The second section of the paper relates to the compounds of platinum, and comprehends researches on the composition of the protochloride of platinum; on the action of ammonia on biniodide of platinum; and on the action of ammonia on the perchloride of platinum; in which the properties of these substances are detailed and the formulæ expressing their composition deduced.

There was also read, "Magnetic Observations made at Prague for September 1841." By C. Kreil. Communicated by S. Hunter Christie, Esq., M.A., Sec. R.S.

Pursuant to the Notice given from the Chair at the last meeting, a ballot was taken on the question proposed to the Society by the Council, that Mr. William John Bankes, F.R.S., be ejected from the Society: which was decided in the affirmative, and his name was accordingly erased from the Charter-book by the Vice-President in the Chair.

The Society then adjourned over the Easter Recess, to meet again on the 7th of April next.

April 7, 1842.

WILLIAM THOMAS BRANDE, Esq., V.P. in the Chair.

The following papers were read, viz.—

Meteorological Observations, taken in conformity with the Report drawn up by the Committee of Physics, including Meteorology, for the guidance of the Antarctic Expedition, as also for the fixed Magnetic Observatories, transmitted to the Society by the Lords Commissioners of the Admiralty and the Master-General of the Ordnance, and communicated by the Council, were read; viz.—

1. "Meteorological Observations taken on board H.M. Ship Erebus, for August and September 1841." By Capt. James Clark Ross, R.N., F.R.S., Commander of the Expedition. (*Forms* 1 and 2.)

2. "Meteorological Observations taken by the Niger Expedition, for May, June and July 1841."

3. "Meteorological Observations taken at the Magnetic Observatory, Ross-Bank, Van Diemen's Land, for November and December 1840, and January, February and March 1841." (*Forms* 1 and 2.)

4. "Meteorological Observations taken at the Magnetic Observatory, Cape of Good Hope, for October and November 1841." By F. Eardley Wilmot, Esq., Lieut. in the Royal Artillery. (*Forms* 1 and 2.)

5. "Meteorological Observations taken at the Magnetic Observatory, Toronto, for January, February, March, April and May 1841."

By C. W. Younghusband, Esq., Lieut. in the Royal Artillery. (*Forms* 1 and 2.)

6. "Of the ultimate distribution of the Air-passages, and of the modes of formation of the Air-cells of the Lungs." By William Addison, Esq., F.L.S., Surgeon, Great Malvern. Communicated by R. B. Todd, M.D., F.R.S.

After reciting the various opinions which have prevailed among anatomists regarding the manner in which the bronchial tubes terminate, whether, as some suppose, by cells having free communication with one another, or, as others maintain, by distinct and separate cells having no such intercommunication, the author states that having been engaged in investigating, with the aid of the microscope, the seat and nature of pulmonary tubercles, he could never discover, in the course of his inquiry, any tubes ending in a *cul-de-sac*; but, on the contrary, always saw, in every section that he made, air-cells communicating with each other. He concludes from his experiments and observations, that the bronchial tubes, after dividing dichotomously into a multitude of minute branches, which pursue their course in the cellular interstices of the lobules, terminate, in their interior, in branched air-passages, and in air-cells which freely communicate with one another, and have a closed termination at the boundary of the lobule. The apertures by which these air-cells open into one another are termed by the author *lobular passages*: but he states that the air-cells have not an indiscriminate or general intercommunication throughout the interior of a lobule, and that no anastomoses occur between the interlobular ramifications of the bronchiæ themselves; each branch pursuing its own independent course to its termination in a closed extremity. Several drawings of the microscopical appearances of injected portions of the lungs accompany this paper.

April 14, 1842.

FRANCIS BAILY, Esq., V.P., in the Chair.

The Rev. Henry Christmas, M.A., was balloted for and duly elected into the Society.

A paper was read, entitled, "Remarks on the probable natural causes of the Epidemic Influenza as experienced at Hull in the year 1833; with a delineation of the Curves of the maximum, the mean, and the minimum Temperatures in the shade, and the maximum Temperature in the sun's rays at Hull, during the years 1823 and 1833." By G. H. Fielding, M.D. Communicated by the Rev. Wm. Buckland, D.D., F.R.S.

The meteorological causes to which the author ascribes the sudden accession of the influenza at Hull, and its continuance from the 26th of April to the 28th of May 1833, are, first, the unusually cold

weather during March, and also the cold and wet which prevailed during April in the same year: secondly, the sudden rise of temperature, amounting to 21° of Fahr., which occurred in a few hours on the 26th of April: and thirdly, the continuance, through May, of extreme vicissitudes of temperature between the day and the night; the burning heat of the days and the cold thick fogs, with easterly winds, commencing generally about sunset, and prevailing during the night.

A paper was also read, entitled, "Report of a remarkable appearance of the Aurora Borealis below the Clouds." By the Rev. James Farquharson, LL.D., F.R.S., Minister of Alford.

The phenomenon recorded in this paper occurred on the night of the 24th of February 1842, when a remarkable aurora borealis was seen by the author apparently situated between himself and lofty stratus clouds, which extended in long parallel belts with narrow intervals of clear sky in a direction from north-west to south-east. The author gives, in detail, the particulars of his observations.

April 21, 1842.

WILLIAM THOMAS BRANDE, Esq., V.P., in the Chair.

The following papers were read:—

1. "On the Organic Tissues in the bony structure of the Corallidæ." By J. S. Bowerbank, Esq. Communicated by Thomas Bell, Esq., F.R.S., was in part read.

"Papers from the several Magnetic Observatories established in India, addressed to the Secretary of the Royal Society, by direction of the Honourable East India Company." Communicated by P. M. Roget, M.D., Sec. R.S.

1. From the Magnetic Observatory at Madras:—

Magnetic and Meteorological Observations for October, November and December 1841; as also for January 1842.

Term-day Observations for October and November, and Curves for August, September, October and November 1841.

Observations of the Direction and Force of the Wind, and the state of the Sky, during October and November 1841.

Extraordinary Magnetic Curves for September, October and December 1841.

2. From the Magnetic Observatory at Singapore:—

Magnetic Observations from March to October, 1841, with Curves for the same period.

Anemometer Curves for March, April, May, June, July, August, September and October 1841.

Abstracts of the Weather for June, July, August and September 1841; as also the Determination of the Temperature at Singapore.

Tide Reports for April, May and June 1841.

3. From the Magnetic Observatory at Simla:—

Abstracts of Magnetic and Meteorological Observations for November and December 1841.

Magnetic Observations for February, May, October and December 1841, with Curves for the same period.

April 28, 1842.

FRANCIS BAILY, Esq., V.P., in the Chair.

A paper, entitled, "On the Organic Tissues in the bony structure of the Corallidæ." By J. S. Bowerbank, Esq., F.G.S., communicated by Thomas Bell, Esq. F.R.S., was resumed and concluded.

The author submitted small portions of nearly seventy species of bony corals to the action of diluted nitric acid, and thus obtained their animal tissue, freed from calcareous matter, and floating on the surface of the fluid in the form of a delicate flocculent mass. By the aid of the microscope, this mass was found to be pervaded by a complex reticulated vascular tissue, presenting numerous ramifications and anastomoses, with lateral branches terminating in closed extremities. There were also found, interspersed among these, another set of tubes, of larger diameter than the former, and provided, in many places, with valves; the branches from these larger vessels occasionally terminate in ovoid bodies, having the appearance of gemmules or incipient polypes. In other cases, masses of still larger size, of a more spherical shape, and of a brown colour, were observed attached to the membrane, and connected with each other by a beautiful network of moniliform fibres. Numerous siliceous spicula, pointed at both extremities and exceedingly minute, were discovered in the membranous structure of several corals; and also other spicula of larger size, terminated at one extremity in a point, and at the other in a spherical head; a form bearing a striking resemblance to that of a common brass pin.

Besides these spicula, the author noticed in these membranous tissues a vast number of minute bodies, which he regards as identical with the nuclei of Mr. Robert Brown, or the cytoblasts of Schleiden.

A paper was also in part read, entitled, "Sixth Letter on Voltaic Combinations," addressed to Michael Faraday, Esq., D.C.L., F.R.S., &c. By John F. Daniell, Esq., For. Sec. R.S., Professor of Chemistry in King's College, London, &c.

May 5, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Henry Frederic Link, Dr. G. S. Ohm, Jean Victor Poncelet, and Henry Rose, were severally elected Foreign Members of the Society.

George Hunsley Fielding, M.D., and John Jesse, Esq., were balloted for and duly elected into the Society.

The reading of a paper, entitled, "Sixth Letter on Voltaic Combinations," addressed to Michael Faraday, Esq., D.C.L., F.R.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain, &c., by John Frederic Daniell, Esq., Foreign Sec. R.S., Professor of Chemistry in King's College, London, was resumed and concluded.

The purport of this letter is to follow the consequences of the law of Ohm, and the expressions which result from it, relative to the electromotive force, and to the resistances in the course of a voltaic circuit; to apply this theory to the verification of the conclusions which the author had formerly deduced from his experiments; and to suggest additional experiments tending to remove some obscurities and ambiguities which existed in his former communications. In following out these principles, the author is led to offer various practical remarks on the different forms of voltaic batteries which have been proposed with a view either to the advancement of our theoretical knowledge of the science, or to the service of the arts. The author enters more particularly into an explanation of the principles on which the cylindric arrangement of the battery he has introduced is founded, which appear to him to have been greatly misunderstood. The formulæ and the calculations which form the body of this paper are not of a nature to admit of being reported in the present abstract.

A paper was also read, entitled, "On Fibre:" additional observations. By Martin Barry, M.D., F.R.S., Lond. and Ed.

On examining coagulating blood, the author finds that it contains discs of two different kinds; the one comparatively pale; the other, very red. It is in the latter discs that a filament is formed; and it is these discs which enter into the formation of the clot; the former, or the pale discs, being merely entangled in the clot, or else remaining in the serum. He thinks that the filament escaped the notice of former observers, from their having directed their attention almost exclusively to the undeveloped discs which remained in the serum, and thus conceived that the blood-discs are of subordinate importance, and are not concerned in the evolution of fibrin.

To render the filament distinctly visible, Dr. Barry adds a chemical reagent capable of removing a portion of the red colouring matter, without altogether dissolving the filament. He employs for

this purpose chiefly a solution of one part of nitrate of silver in 120 parts of distilled water; and sometimes also the chromic acid. He admits that the use of these reagents would, on account of their destructive tendency when concentrated, be objectionable as proofs of the absence of any visible structure; but as the point to be proved is that a certain specific structure does exist, he contends that the same appearance would not equally result from the chemical actions of reagents so different as are those of chrome and the salts of mercury and of silver. After the appearance of the filament, thus brought to light, has become familiar to the eye, it may be discerned in the blood-discs, when coagulation has commenced, without any addition whatever. Those blood-discs of the newt, which contain filaments, often assume the form of flask-like vesicles, the membranes of which exhibit folds, converging towards the neck, where, on careful examination, a minute body may be seen protruding. This body is the extremity of the filament in question, its protrusion being occasionally such as admit of its remarkable structure being recognised.

The author proceeds to describe various appearances which he has observed in the coagulum of the blood, and which strongly resemble those met with in the tissues of the body, and are obviously referable to a similar process of formation. He bears testimony to the accuracy of the delineations of coagulated blood given by Mr. Gulliver. One of the most remarkable phenomena discovered by the author in the coagulation of the blood is the evolution of red colouring matter; a change corresponding to that which he had previously observed to take place in the formation of the various structures of the body out of the corpuscles of the blood. He considers the production of filaments as constituting the essential circumstance in coagulation.

He conjectures that the notched or granulated fibres noticed in the blood by Professor Mayer, may have been of the same kind as the flat, grooved, and compound filaments described by himself; but he thinks that, in that case, Mayer's explanation of their mode of origin must be erroneous; for they may be seen to be produced by a portion of the blood not mentioned by him, namely, the corpuscles.

Mr. Addison's discovery of globules in the uppermost stratum of inflammatory blood, and of their influence in the formation of the buffy coat, is confirmed by Dr. Barry, who remarks that these globules are altered red blood-discs. That the blood corpuscles are reproduced by means of parent-cells, as suggested by Mr. Owen and by the author, is confirmed by the observations of Dr. Remak; but the author had long ago indicated a division of the nucleus as being more particularly the mode of reproduction, not only of those corpuscles, but of cells in general. With this conjecture the observations of Remak on the blood-corpuscles of the fœtal chick fully accord. Whether the author's further speculation, namely, that the parent-cells are altered red blood-discs, is correct, still remains to be seen.

The phenomenon of the "breaking off short," or notching of the fasciculus of a voluntary muscle in a transverse cleavage of the fibre, is regarded by Dr. Barry as a natural consequence of the interlacing of the larger spirals, which he has described in a former paper; the fracture, in proceeding directly across the fasciculus, taking the direction in which there is least resistance.

The position of the filament in the blood-corpuscle is represented as bearing a striking resemblance to that of the young in the ovum of certain intestinal worms, the filaments of which are reproduced by spontaneous division. The author subjoins the following quære, "Is the blood-corpuscle to be regarded as an ovum?"

May 12, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following papers were read, viz.—

1. "Barometrical Observations, showing the effect of the Direction of the Wind on the Difference between distant Barometers." By Lieut.-Colonel Philip Yorke, S. F. Guards. Communicated by Lieut.-Colonel Sabine, R.A., F.R.S., &c.

The author institutes a comparison between the barometric heights as observed at the Apartments of the Royal Society, and at his house in Herefordshire, in the neighbourhood of Ross, with a view to ascertain the influence of prevailing winds on the atmospheric pressure. The barometers thus compared together were of the same construction, and by the same maker; and the times of observation, namely nine o'clock A.M. and three o'clock P.M., were the same at both places, the distance between which is 110 miles in longitude, and about 20 in latitude. The degree of accordance in the march of the two barometers is exhibited by that of curves traced on three sheets accompanying the paper. The results are given in eight tables. The author agrees with Schubler in ascribing the currents prevailing in the atmosphere to the variable relations of heating and cooling which obtains between the Atlantic Ocean and the continent of Europe at different seasons; the facts ascertained by the series of observations here presented being in accordance with that hypothesis. If the northerly and westerly winds in England be partly the effect of the expansion of the air on the continent, then the barometer which is nearest to the continent, or in this instance that at London, ought to be relatively more depressed than the one more distant; or if the southerly and easterly winds be regarded as proceeding to the ocean, then, for a similar reason, the barometer nearest to the ocean ought to be relatively depressed; and that both these effects are produced, is shown by the tables. This view of the subject also, the author remarks, is corroborated by Raymond's observations, detailed in his memoir on the determination of the height of Clermont Ferrand, from which it appears that with the north winds, the

southern barometer was most depressed; while the reverse occurred with the southerly winds.

"On the Rectification and Quadrature of the Spherical Ellipse." By James Booth, Esq., M.A., Principal of Bristol College. Communicated by John T. Graves, of the Inner Temple, Esq., M.A., F.R.S.

The author, at the commencement of this paper, adverts to a rather complex discussion of a portion of the subject of his inquiry by M. Catalan, published in the *Journal de Mathématiques*, edited by M. Lionville.

He then proceeds to establish two fundamental theorems, applicable to,—1st, the quadrature, and 2nd, the rectification of the spherical ellipse.

1st. The quadrature of the spherical ellipse is reduced to the calculation of a complete elliptic function of the third order, whose parameter and modulus are quantities essentially related to the cone; its parameter being the square of the eccentricity of the ellipse, whose plane is at right angles to the axis of the cone, and its modulus being the sine of the semi-angle between the focals.

2nd. The rectification of the spherical ellipse is made to depend on a complete elliptic function of the third order, whose parameter is the same as in the preceding case, but whose modulus is the sine of the angle between the planes of the elliptic base and of one of the circular sections.

The author then proceeds to establish a remarkable relation between the area of a given spherical ellipse and the length of the spherical ellipse generated by the intersection of the supplemental cone with the same sphere.

He shows that if there are two concentric supplemental cones cut by the surface of a concentric sphere,—1st, the *sum* of their spherical bases, together with twice their lateral surfaces, is equal to the surface of the sphere; 2nd, the *difference* of their spherical bases is equal to twice the difference of their lateral surfaces.

Hence, also, he deduces a remarkable theorem, viz. the sum of the spherical bases of any cone whose principal angles are supplemental, cut by a sphere, together with twice the lateral surface of the cone comprised within the sphere, is equal to the surface of the sphere.

The author then, alluding to some researches of Professor MacCullagh and of the Rev. Charles Graves, Fellow of Trinity College, Dublin, proceeds to give a simple elementary proof of a well-known formula of rectification, and thence deduces some remarkable properties of the tangent at that point of the ellipse, which is termed by him the point of *rational section*.

Assuming the properties of the plane ellipse, he proceeds to show that a similar formula of rectification holds for any curve generated by the intersection of a spherical surface with a concentric cone of any order. He goes on to develope a series of properties of the spherical ellipse, bearing a striking analogy, as indeed might have been expected, to those of the plane curve. Thus he establishes a

point of *rational section* as in the plane ellipse, shows that the tangent arc is at this point a *minimum*, and developes some other curious analogies. It is a simple consequence of his formula that the spherical elliptic quadrant may be divided into two arcs whose difference shall be represented by an arc of a great circle. This theorem, previously obtained by M. Catalan, is analogous to that of Fagnani, which shows that the difference of two plane elliptic arcs may be represented by a straight line.

The author concludes by reducing the quadrature of the surface of a cone of the second degree, bounded by a plane perpendicular to the axis, to the determination of a complete elliptic function of the second order.

The Society then adjourned over the Whitsun Recess, to meet again on the 26th instant.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 54.

May 26, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Thomas Chapman, Esq., was balloted for, and duly elected into the Society.

Richard Quain, Esq., was also balloted for, but was not elected into the Society.

A paper was in part read, entitled, "On the Transparency of the Atmosphere, and the Law of Extinction of the Solar Rays in passing through it." By James D. Forbes, Esq., F.R.S., Sec. R.S. Edinb., Professor of Natural Philosophy in the University of Edinburgh.

June 2, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The reading of a paper, entitled, "On the Transparency of the Atmosphere, and the Law of Extinction of the Solar Rays in passing through it." By James D. Forbes, Esq., F.R.S., &c., was resumed and concluded.

This paper is divided into seven sections. In the first, the qualities of heat and light are considered in as far as they modify the comparability and absolute nature of our measures of the influence of the solar rays. All instruments, whether called *Thermometers*, *Photometers*, or *Actinometers*, measure but the peculiar effect to which their construction renders them sensible, but are incompetent to give absolute measures of either heat or light.

The second section treats of the history of the problem of the law and measure of extinction of the solar rays in passing through the atmosphere of the earth in clear weather. The labours of Bouguer, Lambert, De Saussure, Leslie, Herschel, Kämtz and Pouillet are successively passed under review, and their instrumental methods considered.

In the third section, a mathematical problem of considerable difficulty and interest is investigated; principally after the manner of

Laplace. It consists in the determination of the length of the path and the mass of air which a ray of light must traverse in passing through the earth's atmosphere at every different angle of obliquity. The author determines the numerical value of these quantities for all angles of incidence from 0° to 90°.

The fourth section contains an account of the observations made by the author in conjunction with Professor Kämtz in 1832. These were conducted in 1832 at the top and bottom of the Faulhorn, a mountain of the canton of Berne in Switzerland. The lower station was Brientz, and the intercepted stratum of air had 6800 English feet of thickness, corresponding in its weight to about one-fourth of the entire atmosphere. Frequent observations were simultaneously made with the actinometer and other meteorological instruments at both stations, and the loss of solar heat in passing through the intervening mass of air was thus directly determined.

In the fifth section, the observations made from sunrise to sunset, on one peculiarly favourable day (the 25th September, 1832), are carefully analysed; and from the absorption at various obliquities, the law of extinction in the atmosphere, within the limits of observation, is attempted to be deduced.

The sixth and seventh sections include the results of similar, but less perfect observations in 1832 and in 1841.

From the facts and reasonings of this paper, the author deduces, on the whole, the following conclusions:—

1. The absorption of the solar rays by the strata of air to which we have immediate access is considerable in amount for even moderate thicknesses.

2. The diurnal curve of solar intensity has, even in its most normal state, several inflections; and its character depends materially on the elevation of the point of observation.

3. The approximations to the value of extra-atmospheric radiation, on the hypothesis of a geometrical diminution of intensity, are inaccurate.

4. The tendency to absorption through increasing thicknesses of air is a diminishing one; and in point of fact, the absorption almost certainly reaches a limit beyond which no further loss will take place by an increased thickness of similar atmospheric ingredients. The residual heat, tested by the absorption into a blue liquor, may amount to between half and a third of that which reaches the surface of the earth after a vertical transmission through a clear atmosphere.

5. The law of absorption in a clear and dry atmosphere, equivalent to between one and four thicknesses of the mass of air traversed vertically, may be represented, within those limits, by an intensity diminishing in a geometrical progression, having for its limit the value already mentioned. Hence the amount of vertical transmission has always, hitherto, been greatly overrated; or the value of extra-atmospheric solar radiation greatly underrated.

6. The value of extra-atmospheric solar radiation, on the hypothesis of the above law being generally true, is 73° of the actino-

meter marked B 2. The limiting value of the solar radiation, after passing through an *indefinite* atmospheric thickness, is 15° 2′.

7. The absorption, in passing through a vertical atmosphere of 760 millimeters of mercury, is such as to reduce the incident heat from 1 to 0·534.

8. The physical cause of this law of absorption appears to be the non-homogeneity of the incident rays of heat, which, parting with their more absorbable elements, become continually more persistent in their character; as Lambert and others have shown to take place, when plates of glass are interposed between a source of heat and a thermometer.

9. Treating the observations on Bouguer's hypothesis of a uniform rate of extinction to the intensity of the incident rays, the author obtains for the value of the vertically transmitted shares of solar heat in the entire atmosphere,—

By the *relative* intensities at Brientz and the Faulhorn		0·6842
By the observations at the Faulhorn alone,—	First method	0·6848
	Second method	0·7544
By the observations at Brientz alone,—	First method	0·7602
	Second method	0·7827

The President informed the Meeting that the Council had voted the following Address to Her Majesty, the Queen.

" *To the Queen's Most Excellent Majesty.*

" The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

" Most Gracious Sovereign,

" We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to approach Your Majesty's throne with the expression of our deep sorrow that any subject of Your Majesty should dare to lift his arm against Your Majesty's sacred person. We offer up to Divine Providence the grateful homage of our hearts, that He has been graciously pleased to guard a life so valuable to all the inhabitants of these realms; and we pray most fervently that the same Almighty Protection may long preserve Your Majesty in the possession of health and every other blessing to your family and your people."

The President informed the Meeting that the Council had adopted the following Address to His Royal Highness Prince Albert of Saxe Coburg and Gotha :—

"*To His Royal Highness Prince Albert of Saxe Coburg and Gotha, K.G., F.R.S., &c.*

"The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg to be permitted, on the present occasion, to offer to Your Royal Highness our congratulation on the providential escape of Her Majesty and Your Royal Highness from the murderous attack of an assassin.

"That the same Almighty Arm may continue to preserve Her Majesty and Your Royal Highness from every danger, and from every evil, is our most sincere and earnest prayer."

June 9, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

A paper was read, entitled, "On the Specific Inductive Capacities of certain Electric Substances." By William Snow Harris, Esq., F.R.S.

The author, pursuing the experimental inquiry suggested by the theory of Mr. Faraday relative to the differences in specific inductive capacity exhibited by different dialectric substances, instituted a series of experiments for determining with precision their comparative powers of insulation, and of sustaining by induction charges of electricity. The substances to be examined were cast into the form of circular plates and furnished on both their surfaces with circular coatings of tinfoil of a diameter equal to one-half that of the plate, and the electric intensities were measured by electrometers of the same construction as those which he used in his former experiments, and which he has described in his papers already published in the Philosophical Transactions for 1839. The results are stated in tables; from the last of which it appears that the inductive capacities of the dialectric bodies tried, that of air being expressed by unity, are proportional to the following numbers:—

Substances.	Relative capacities.
Air	1
Rosin	1·77
Pitch	1·8
Bees' wax	1·86
Glass	1·9
Brimstone	1·93
Shell-lac	1·95

The author, in conclusion, offers some observations on the expe-

rimental processes employed in his investigation; and points out several circumstances which require to be attended to in order to ensure success.

June 16, 1842.

SIR JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

The following papers were read, viz.—

1. "On the Action of the Rays of the Solar Spectrum on Vegetable Colours." By Sir John Frederick William Herschel, Bart., K.H., F.R.S.

The author, having prosecuted the inquiry, the first steps of which he communicated in a paper read to the Royal Society in February 1840, relating to the effects of the solar spectrum on the colouring matter of the *Viola tricolor*, and on the resin of guaiacum, relates, in the present paper, the results of an extensive series of similar experiments, both on those substances, and also on a great number of vegetable colours, derived from the petals of flowers, and the leaves of various plants. In the case of the destruction of colour of the preparations of guaiacum, which takes place by the action of heat, as well as by the more refrangible rays of light, he ascertained that although the non-luminous thermic rays produce an effect, in as far as they communicate heat, they are yet incapable of effecting that peculiar chemical change which other rays, much less copiously endowed with heating power, produce in the same experiment. He also found that the discoloration produced by the less refrangible rays is much accelerated by the application of artificial terrestrial heat, whether communicated by conduction or by radiation; while, on the other hand, it is in no degree promoted by the purely thermic rays beyond the spectrum, acting under precisely similar circumstances, and in an equal degree of condensation. The author proceeds to describe, in great detail, the photographic effects produced on papers coloured by various vegetable juices, and afterwards washed with solutions of particular salts; and gives a minute account of the manipulations he employed for the purpose of imparting to paper the greatest degree of sensitiveness to the action of solar light. This action he found to be exceedingly various, both as regards its total intensity and the distribution of the active rays over the spectrum. He observed, however, that the following peculiarities obtain almost universally in the species of action exerted.

First, the action is *positive*; that is to say, light destroys colour, either totally, or leaving a residual tint, on which it has no further, or a very much slower action; thus effecting a sort of chromatic analysis, in which two distinct elements of colour are separated, by destroying the one and leaving the other outstanding. The older the paper, or the tincture with which it is stained, the greater is the amount of this residual tint.

Secondly, the action of the spectrum is confined, or nearly so, to the region of it occupied by the luminous rays, as contra-distinguished both from the so-called chemical rays beyond the violet, (which act with chief energy on argentine compounds, but are here for the most part ineffective,) on the one hand, and on the other, from the thermic rays beyond the red, which appear to be totally ineffective. Indeed, the author has not hitherto met with any instance of the extension of this description of photographic action on vegetable colours beyond, or even quite up to the extreme red.

Besides these, the author also observed that the rays which are effective in destroying a given tint, are, in a great many cases, those whose union produces a colour complementary to the tint destroyed, or at least one belonging to that class of colours to which such complementary tint may be referred. Yellows tending towards orange, for example, are destroyed with more energy by the blue rays; blues by the red, orange and yellow rays; purples and pinks by yellow and green rays. These phenomena may be regarded as separating the luminous rays by a broadly defined line of chemical distinction from the non-luminous; but whether they act *as such*, or in virtue of some peculiar chemical quality of the heat which accompanies them *as heat*, is a point which the author considers his experiments on guaiacum as leaving rather equivocal. In the latter alternative, he observes, chemists must henceforward recognise, in heat from different sources, differences not simply of intensity, but also of quality; that is to say, not merely as regards the strictly chemical changes it is capable of effecting in ingredients subjected to its influence.

One of the most remarkable results of this inquiry has been the discovery of a process, circumstantially described by the author, by which paper washed over with a solution of ammonio-citrate of iron, dried, and then washed over with a solution of ferro-sesquicyanuret of potassium, is rendered capable of receiving with great rapidity a photographic image, which, from being originally faint and sometimes scarcely perceptible, is immediately called forth on being washed over with a neutral solution of gold. The picture does not at once acquire its full intensity, but darkens with great rapidity up to a certain point, when the resulting photograph attains a sharpness and perfection of detail which nothing can surpass. To this process the author applies the name of *Chrysotype*, to recall to mind its analogy with the Calotype process of Mr. Talbot, to which in its general effect it affords so close a parallel.

2. "Experimental Researches on the Elliptic Polarization of Light." By the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

This paper contains an experimental investigation of the phenomena of elliptic polarization resulting from the reflexion of polarized light from metallic surfaces, and the theory on which they are explicable; the analytical results being given in a tabular form, and applied to the cases of the experiments themselves.

3. " On the Influence of the Moon on the Atmospheric Pressure, as deduced from the Observations of the Barometer made at the Magnetic Observatory at St. Helena." By Lieutenant J. H. Lefroy, R.A., late Director of that Observatory. Communicated by Lieut.-Col. Sabine, R.A., F.R.S.

In order to determine the dependence of the barometric pressure on lunar influence, the author arranges all the two-hourly observations in each lunar month with relation to the time of the moon's passing the meridian; entering in one column the observation of each day nearest to the meridian passage, whether before or after; and entering in separate columns those corresponding to two hours, four hours, six hours, &c., before and also after that observation. The monthly means at every two hours from the meridian passage are then taken; and again, the means at the same intervals, for each three months from September 1840 to December 1841. From the results thus obtained the author states that it appears that the moon's passage over both the inferior and superior meridian produces a slight increase of pressure; a maximum in the curve occurring at both (that of the latter being slightly the greater), while the minima correspond to the moon's rising or setting.

It appears also, that the rise of the tides will not account for the whole amount of the increase of pressure, even admitting that it has a tendency to produce an effect of that nature. The times of maxima do not correspond; and there appears to be no atmospheric establishment. The pressure is greater about the period of new moon than at full moon; and greater in the third and fourth than in the first and second quarters; a result which agrees with that given by Mr. Howard for the climate of London. The observations of both years agree in making the pressure greater under the Perigee than under the Apogee. Mr. Howard had found that the mean pressure in Great Britain, which is in the opposite hemisphere from St. Helena, is greater under the Apogee than under the Perigee.

4. " Notices of the Aurora Australis from the 1st to the 31st of March 1841, made on board H.M.S. Erebus; extracted from the log-book." By Captain James Clark Ross, R.N., F.R.S.

5. "An Appendix to a paper on the Nervous Ganglia of the Uterus, with a further Account of the Nervous Structures of that Organ." By Robert Lee, M.D., F.R.S.

After premising a short history of the opinions of Galen, Dr. William Hunter, Mr. John Hunter, Professor Tiedemann, Professor Lobstein, and Professor Osiander, relative to the existence, course, and enlargement of the nerves of the uterus, the author adverts to his own researches on this subject, which commenced with his discovery, in April 1838, of the trunk of a large nerve accompanying the uterine vein, and of the great nervous plexus with which it was continuous. Of this discovery he gave an account to the Royal Society in a paper read on the 12th of December of the same year. In a subsequent paper, he described some large nervous ganglia

situated at the neck of the uterus; and in the present appendix he describes other nervous structures of still greater size which presented themselves to him, on a still more complete dissection which he made of a gravid uterus at the full period of gestation. It appears from the results of these dissections that the human uterus possesses a great and extensive system of nerves, which enlarge during pregnancy, along with the coats, blood-vessels, and absorbents of that organ, and which after parturition resume their original condition. It is chiefly through the influence conveyed by these nerves that the uterus is rendered capable of performing its various functions, and by which sympathies are established between it and other parts of the system.

6. "Magnetic-term Observations of the Declination, Inclination and Total Intensity, made at the Magnetic Observatory at Prague, for February, March, and April 1842." By C. Kreil, Director of the Prague Observatory. Communicated by S. Hunter Christie, Esq., M.A., Sec. R.S.

7. "Magnetic and Meteorological Observations for February 1842, taken at the Magnetic Observatory at Madras." Presented by the Honourable Court of Directors of the East India Company. Communicated by the Council of the Royal Society. (*Packet No.* 73.)

8. "Magnetic and Meteorological Observations from May 1841 to March 1842, made at the Observatory established by the Rajah of Travancore, at Trevandrum, transmitted to the Royal Society by command of His Highness the Rajah." By John Caldecott, Esq., F.R.S., Director of the Observatory at Trevandrum.

The Society then adjourned over the long vacation, to meet again on the 17th of November next.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 55.

November 17, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following gentlemen were, by ballot, elected Auditors of the Treasurer's Accounts, on the part of the Society: viz. Martin Barry, M.D., Henry James Brooke, Esq., Robert Brown, Esq., D.C.L., Rev. James Cumming, M.A., and John Thomas Graves, Esq., M.A.

James Scott Bowerbank, Esq., and Charles Towneley, Esq., were balloted for and duly elected Fellows of the Society.

The following papers were read, viz:—

1. Postscript to a paper "On the Action of the Rays of the Solar Spectrum on Vegetable Colours." By Sir John Frederick William Herschel, Bart, F.R.S., &c.

An account is here given of some additional facts illustrative of the singular properties of iron as a photographic ingredient, and also of some highly interesting photographic processes dependent on those properties, which the favourable weather of the summer has enabled him to discover. The author also describes a better method of fixing the picture, in the process which he has denominated the *Chrysotype*, than that which he had specified in the latter part of his paper. In this new method the hydriodate is substituted for the hydrobromate of potass; and the author finds it perfectly effectual; pictures fixed by it not having suffered in the smallest degree, either from long exposure to sunshine or from keeping.

He next considers the class of processes in which cyanogen, in its combinations with iron, performs a leading part, and in which the resulting pictures are blue; processes which he designates by the generic term *Cyanotype*. Their varieties appear to be innumerable, but one is particularly noticed, namely, that of simply passing over the ammonio-citrated paper, on which a latent picture has been impressed, very sparingly and evenly, a wash of the solution of the common yellow ferrocyanate of potass. As soon as the liquid is applied the negative picture vanishes, and is replaced, by very slow degrees, by a positive one, of a violet-blue colour on a greenish-yellow ground, which, at a certain moment, possesses a high degree

of sharpness, and singular beauty and delicacy of tint. From his further researches on this subject he deduces the following conclusions: first, that it is the heat of the rays, not their light, which operates the change; secondly, that this heat possesses a peculiar chemical quality, which is not possessed by the purely calorific rays outside of the visible spectrum, though far more intense; and thirdly, that the heat radiated from obscurely hot iron abounds especially in rays analogous to those of the region of the spectrum above described.

The author then describes the photographic properties he has discovered to belong to mercury, a metal which he finds to possess, in an eminent degree, direct photographic susceptibility.

2. "Observations de la variation de la déclinaison et intensité horizontale magnétiques observées à Milan pendant vingt-quatre heures consécutives, le 22 et 23 Juin, le 20 et 21 Juillet, le 26 et 27 d'Aout, le 21 et 22 Septembre, et le 19 et 20 Octobre, 1842," rapportées par Robert Strambrecchi, premier élève adjoint.

A letter was also read from Sir John F. W. Herschel on the subject of Photography, addressed to S. Hunter Christie, Esq., Sec. R.S.

November 24, 1842.

FRANCIS BAILY, Esq., Vice-President, in the Chair.

The following papers were read, viz:—

1. "On certain improvements on Photographic Processes described in a former communication." By Sir John Frederick William Herschel, Bart, K.H., F.R.S., &c., in a letter to Samuel Hunter Christie, Esq., Sec. R.S. Communicated by Mr. Christie.

The present memoir, which is a sequel to the last by the same author, is accompanied by a series of photographic impressions illustrative of the chrysotype, cyanotype, and other processes formerly described by him. Some improvements which he has introduced into these processes are given, together with a few remarks on some other points treated of in the former paper, in relation to the influence of *thermic rays* as distinct from *calorific rays*; the former being rays, which in the spectrum accompany the red and orange rays, which are also copiously emitted by heated bodies short of redness, and which are distinguished from those of light by being invisible. The author thinks they may be regarded as bearing the same relation to the calorific spectrum which the photographic rays do to the luminous one, and would propose to designate them by the term *parathermic rays*. He conceives that these may be the rays which are active in producing those singular molecular affections determining the precipitation of vapours in the experiments of Messrs. Draper, Moser, and Hunt, and which will probably lead to important discoveries as to the intimate nature of those forces, resident on

the surfaces of bodies, to which M. Dutrochet has given the name of *epipolic forces*.

2. "Boring Register, Bow Island, South Pacific." By Captain Edward Belcher, R.N., communicated by Captain Beaufort, R.N., F.R.S.

The results of the boring operations carried on in this island are here given, as well as the register of the daily proceedings, under the particular superintendence of Mr. Thomas Pass, acting master of H.M.S. Sulphur. The depth reached was 45 feet, when the augur broke, and no further progress could be made.

November 30, 1842.

At the Anniversary Meeting,

The MARQUIS OF NORTHAMPTON, President, in the Chair.

John Thomas Graves, Esq., M.A., on the part of the Auditors of the Treasurer's Accounts, reported, that the total receipts during the last year, inclusive of a balance of 609*l.* 2*s.* 8*d.*, carried from the account of the preceding year, amounted to 3959*l.* 0*s.* 10*d.*; and that the total payments in the same period amounted to 2813*l.* 17*s.* 5*d.*, leaving a balance in the hands of the Treasurer of 1145*l.* 3*s.* 5*d.*

The thanks of the Meeting were given to the Auditors for the trouble they have taken in examining the Treasurer's accounts.

The thanks of the Meeting were voted to the Treasurer.

The Secretary read the following list of deceased Fellows of the Royal Society since the last Anniversary in 1841; of those ejected, and of Fellows admitted into the Royal Society since the last Anniversary.

List of Fellows of the Royal Society deceased since the last Anniversary (1841).

On the Home List.

Sir William Beatty, Knt., M.D.
Sir Charles Bell, K.H.
Thomas Blizard, Esq.
Lt.-Col. Sir Alex. Burnes, Knt.
Sir William Burroughs, Bart.
Richard Hart Davis, Esq.
Joseph Delafield, Esq.
John Dickenson, Esq.
The Right Hon. Sir William Garrow, Knt.
Lord Francis Gray.
Francis George Hare, Esq.
Henry Hennell, Esq.
Sir Henry Hugh Hoare, Bart.
James Ivory, Esq., K.H., M.A.
Joseph Jekyll, Esq. M.A.
Aylmer Bourke Lambert, Esq.
The Earl of Macclesfield.
The Earl of Munster.
The Duke of Norfolk.
John Gage Rokewode, Esq.
Samuel Seaward, Esq.
Henry Harper Spry, Esq.
Lord Vivian.
Lieut. J. R. Wellstead, I.N.
John Yelloly, M.D.

Ejected.

William John Bankes, Esq.

List of Admissions into the Royal Society since the last Anniversary (1841).

On the Home List.

Capt. William Allen, R.N.
Edw. Hodges Baily, Esq., R.A.
John Joseph Bennett, Esq.
James Scott Bowerbank, Esq.
Rob. Edwards Broughton, Esq.
Thomas Chapman, Esq.
Rev. Henry Christmas, M.A.
Ardaseer Cursetgee, Esq.
William Fishburn Donkin, Esq.
Geo. Hunsley Fielding, M.D.
John Jesse, Esq.
Cuthbert William Johnson, Esq.
The Earl of Lovelace.
Major Gen. Wm. Morison, C.B.
Lieut. Tho. J. Newbold, E.I.C.S.
Samuel Peace Pratt, Esq.
Lieut. Chas. Jas. B. Riddell, R.A.
Capt. Owen Stanley, R.N.
Thomas Glanville Taylor, Esq.
Joseph Toynbee, Esq.

On the Foreign List.

His Majesty the King of Prussia.
Henry Frederic Link.
Dr. G. S. Ohm.
Jean Victor Poncelet.
Henry Rose.

The President then addressed the meeting as follows:

GENTLEMEN,

I MUST commence my address to you by the expression of my regret that my absence from England at this period of the last year prevented my being then able to meet you at your Anniversary. The gratitude which it has behoved me to intimate to my Council on former occasions for their assistance in the discharge of my presidential duties, it is more than ever necessary for me now to feel, as it was that assistance that rendered my absence no real detriment to the Society.

During that absence, an event took place to which I am bound to refer,—I allude to the visit to this city of the sovereign of another country at the time of the auspicious baptism of His Royal Highness the Prince of Wales. His Prussian Majesty was pleased to join our Society. At this I heartily rejoice, as I believe it to be a happy omen for mankind when those who are placed in exalted situations show their sympathy with scientific pursuits. I congratulate the Prussian nation, that her sovereign has taken so early an opportunity of countenancing science, and of declaring his opinion that the natural philosopher is a friend to good government, to order, and to civilization.

The pleasure experienced by you on this occasion was enhanced by the presence within these walls of Baron Humboldt, who accompanied his Majesty. It is very seldom that we can expect to see among us any of our Foreign Associates. It was therefore doubly gratifying to receive, together with his sovereign, the distinguished philosopher who had travelled over so large a portion of the globe in the pursuit of every branch of knowledge.

Since I last addressed you, two years ago, a great degree of success has attended the expedition of Captain Ross to the Antarctic Region. I congratulate you, Gentlemen, on the results already derived from an expedition which originated in a joint application to Government from your Council and the British Association. I rejoice that a British officer has had the honour, not only of making most important scientific researches, but also of approaching much nearer to the Southern Pole than any one had done before him, and of discovering a new Iceland and a new Hecla, more gigantic than the arctic volcano.

With respect to the magnetic observatories, I have the gratification of informing you that they are to be continued for three more years, in hopes of making the information to be obtained from them more extensive and more accurate. The consent to this continuance was granted by Sir Robert Peel: a continuance of the scientific measure of one minister by the statesman who had superseded and succeeded him. This is a gratifying circumstance, as proving that, as we hope and believe that British patriotism belongs to all parties, so the love of science also belongs to all, or rather that in scientific pursuits there is no party feeling and no party jealousy. I must add, that on the present occasion, the application of the Council of the Royal Society was seconded by M. Brunow, the ambassador of the Emperor of Russia; thus showing that nations are ready to testify that any great acquisition of physical knowledge is a common object to the whole human race.

The hopes that the Expedition to the Niger might be productive of important additions to our stores of science, as well as great results to the highest interests of humanity, have been unhappily in a great measure disappointed. At the same time the hopes of the scientific naturalist have not been entirely vain, for I am informed by Mr. Gray that many new species of birds and other animals have been brought to England from Fernando Po and the mouth of the Niger.

Your Council, Gentlemen, have taken into their consideration the great importance that microscopical researches have always possessed, and the still greater influence upon science that they are now beginning to exercise, in the hands of Mr. Owen and others, as well as the extraordinary perfection to which the instrument itself is now brought. They have come to the conclusion that it is highly expedient that we should ourselves possess the means of repeating and verifying the experiments brought before our notice, as well as instituting new branches of inquiry. We have therefore thought it expedient, by summoning competition to our aid, to endeavour to

obtain one of the best microscopes that can be constructed. Indeed we feel sure, that, independently of the liberal price that we have offered, there is no optician who would not feel highly gratified on seeing within these walls an instrument constructed by him.

The room, Gentlemen, in which we are met, has had some changes made in the pictures which adorn its walls. In consequence of these changes you will see, in addition to those portraits to which you are accustomed, the likeness of one of the most distinguished of our body; of one who was equally eminent in natural philosophy and in archæology. Our posterity, Gentlemen, will probably hereafter be at a loss whether to admire Dr. Young most in his pursuits of natural knowledge, or in his discovery of the key to the greatest mystery of bygone ages,—the hieroglyphical writing of the Egyptians.

You will not be less pleased to see another portrait of a venerable philosopher still spared to us—of that great and original chemist, Dr. Dalton.

I have to congratulate you also on the possession of the bust of a lady whose acquirements are an honour to her sex and to her country; and I feel sure that the likeness of Mrs. Somerville, from the hand of our lamented Chantrey, will ever be highly prized by the Royal Society.

In addition to these ornaments to our Apartments, since I addressed you in our Anniversary Meeting of 1840, I must not pass over the portrait of Mr. Dollond, to whom the astronomer is so much indebted for his improvement in the art of constructing telescopes; and I should be wholly inexcusable if I omitted the valuable picture given to us by Mr. Vignolles, and representing the prince of English science, the immortal Sir Isaac Newton.

I am happy to state that the Royal Society has not, during the past year, had to lament the death of any one of her Foreign Members. We could not reasonably hope that such should be the case among her British Fellows. I shall now, Gentlemen, conclude, as usual, by a short account of some of the more remarkable men, whether for scientific research, or for public services, whom the Royal Society has had the misfortune to lose since last November.

Among the deceased Fellows of the present year, we have to lament the loss of one of the most eminent surgeons and physiologists of our times—one whose investigations and discoveries have shed a new light on that most intricate part of the human organization—the Nervous System.

Sir Charles Bell, K.H., F.R.S. L. and E., &c., the youngest son of the Rev. W. Bell, of the episcopal church of Scotland, was born at Edinburgh in the year 1778. While a mere youth, he was instructed in the elements of anatomical science by his brother Mr. John Bell (himself a distinguished surgeon and anatomist), and at a very early period he published the first part of "Plates of Dissections", a work alike remarkable for the fidelity of the anatomical

details, and the spirited style of the illustrations from the pencil of the author.

In 1799, Mr. Charles Bell was admitted a member of the Royal College of Surgeons of Edinburgh, and soon afterwards was appointed one of the surgeons of the Royal Infirmary in that city, where he acquired a high reputation as a skilful and dexterous operator.

In 1806, he removed to London; and by his own unaided exertions, established himself as a lecturer on Anatomy and Surgery. He was subsequently associated with Mr. Wilson in the celebrated anatomical school of Great Windmill Street, and speedily became one of the most popular and effective lecturers in the surgical schools of London; although at that period, Cline, Cooper, Abernethy, and other eminent men, were in the zenith of their fame as professional teachers.

He was elected Surgeon to the Middlesex Hospital in 1812.

A few years afterwards he was appointed Professor of Anatomy and Surgery to the Royal College of Surgeons of London, in which capacity he delivered a series of lectures, which excited in an extraordinary degree the interest and attention of the profession, the theatre of the College being crowded to the conclusion of the course.

Immediately after the battle of Waterloo, Mr. Charles Bell, with that humanity and zeal for the pursuit of professional knowledge which marked his character, proceeded to Brussels, and tendered his assistance to the wounded soldiers in the hospitals of that city; and after his arrival he was incessantly engaged for three successive days and nights in the operations and dressings of upwards of 300 cases.

In 1826, Mr. Charles Bell was admitted a Fellow of the Royal Society.

On the institution of the London University College, in 1828, Mr. Charles Bell was chosen Principal of the Medical School; and he delivered the opening lecture in that department of the College, and also a course of lectures on Physiology.

On the accession of William IV. to the throne, Mr. Charles Bell, together with a limited number of other men of distinguished scientific attainments, received the honour of knighthood.

A "Treatise on Animal Mechanics," composed by Sir Charles Bell for the Society for the Diffusion of Useful Knowledge, being the substance of some of the lectures which he had delivered before the College of Surgeons, contained so powerful and lucid an exposition of the proofs of creative design, as exemplified in the structure of the human frame, that our late President, Mr. Davies Gilbert, was led to select the author as one of the Bridgewater Essayists. "An Essay on the Hand, its mechanism and its vital endowments as evincing design," is the title of the admirable volume which Sir Charles Bell, in accordance with the provisions of the appointment, contributed to those celebrated essays.

Sir Charles Bell, in conjunction with Lord Chancellor Brougham,

also published "Illustrations of Dr. Paley's Evidences of Natural Theology."

In 1836, he accepted the Chair of Surgery in the University of Edinburgh, to which he was invited by the unsolicited and unanimous vote of the patrons of that institution; and he left London to place himself at the head of the profession in his native city. In this new sphere of usefulness he continued to pursue with undiminished ardour the cultivation of surgery and physiology until his death, which took place on the 29th of April, 1842, at Hallow Park, in Worcestershire.

With this brief sketch of the professional career of Sir Charles Bell, I proceed to notice those original and important investigations into the nature and functions of the nervous system, upon which his high reputation as a physiologist is based, which entitle him to be ranked among the most distinguished Fellows of this Society, and for which he was deservedly awarded the first Royal Medal we had to bestow.

The earliest contribution of Sir Charles Bell to our Transactions was in 1821, "On the Nerves, giving an account of some experiments on their structure and functions, which lead to a new arrangement of the system." This was followed by other essays on the same subject, which were severally published in the Philosophical Transactions for 1822, 1823, 1826, 1829, 1832, 1834, 1835, and 1840.

In the last communication, entitled "On the Nervous System," the author gives a condensed view of his investigations and discoveries, the result of more than thirty years of indefatigable labour and research.

As long since as 1806, in the first edition of his beautiful work "On the Anatomy of Expression in Painting," we perceive the germ of those original views of the nervous system, which it was the labour of his life to elucidate and establish. "If," he observes, "we had but a perfect knowledge of the functions of the nerves, they would on all occasions inform us of the cause of those actions which now appear to us so inexplicable." And here I may observe, that the drawings which illustrate this work are in the first style of art, and show, that had the author chosen painting as a profession, he would have attained a distinguished rank as an artist.

In 1811, in a small work entitled "An Idea of a new Anatomy of the Brain, submitted for the observation of his friends, by Charles Bell, F.R.S.E," he distinctly enunciates those original opinions, which, modified and extended by subsequent investigations and discoveries, have led to those enlarged and philosophical views of the phenomena of the nervous system, which have so largely contributed to the advancement of physiological science.

In short, whatever we may owe to the genius and labours of other men in this field of research, the discovery of the grand fundamental principle upon which a correct knowledge of the functions of the nervous system depends, is unquestionably due to Sir Charles Bell.

He was the first to ascertain, not by accident, but by careful and laborious dissections and experiments, and by a cautious induction from the phenomena which his talents and unwearying industry enabled him to develope, that "the nerves which we trace in the body are not single nerves possessing different powers, but are bundles of different nerves whose filaments are enclosed in one common sheath, but which are as distinct in function as they are in origin; that they depend for their specific attributes on the nervous masses to which they are severally attached; that the spinal nerves arising from the lateral and anterior columns of the medulla spinalis convey the power of motion, while the nerves arising from the posterior strands communicate the faculty of sensation to the several parts of the body to which they are distributed." The nerves which arise from the middle and upper columns of the spinal marrow, Sir Charles conceived to be designed for the act of respiration; and these he termed the "*system of respiratory nerves.*"

Having thus established the principle by anatomy and experiment, that the nerves possess distinct functions in correspondence with their origin from different parts of the brain and spinal marrow, Sir Charles Bell followed up his inquiries by collecting such pathological facts as served to illustrate and confirm the opinions he had advanced; and our Transactions are enriched by numerous memoirs relating to this most important subject. His essays on the nerves of the face in health and disease are of the deepest interest, and their practical value cannot be too highly estimated. In fact, the great advancement which has been made of late years in our knowledge of the nature and treatment of the diseases of the nervous system, is mainly attributable to the labours and discoveries of Sir Charles Bell*.

* A list of Sir Charles Bell's contributions to the Philosophical Transactions is subjoined.

1. On the Nerves; giving an Account of some Experiments on their Structure and Functions, which lead to a new arrangement of the System. (Phil. Trans. 1821, p. 398.)

2. Of the Nerves which associate the Muscles of the Chest, in the actions of Breathing, Speaking and Expression; being a continuation of the paper on the Structure and Functions of the Nerves. (Ibid. 1822, p. 284.)

3. On the Motions of the Eye, in illustration of the Uses of the Muscles and Nerves of the Orbit. (Ibid. 1823, p. 166.)

4. Second part of the paper on the Nerves of the Orbit. (Ibid. 1823, p. 289.)

5. On the Nervous Circle which connects the voluntary Muscles with the Brain. (Ibid. 1826, Part II. p. 163.)

6. On the Nerves of the Face; being a second paper on that subject. (Ibid. 1829, p. 317.)

7. Of the Organs of the Human Voice. (Ibid. 1832, p. 299.)

8. On the Functions of some parts of the Brain, and on the relations between the Brain and Nerves of Motion and Sensation. (Ibid. 1834, p. 471.)

9. Continuation of a paper on the Relations between the Nerves of Motion and Sensation, and the Brain; more particularly on the Structure of the Medulla oblongata and the Spinal Marrow. (Ibid. 1835, p. 255.)

10. On the Nervous System. (Ibid. 1840, p. 245.)

In private life this eminent man was distinguished by the suavity and simplicity of his manners, by his elegant tastes, and domestic virtues *.

Mr. JAMES IVORY was the son of Mr. James Ivory, watchmaker in Dundee, and was born in that town in the year 1765. He received his elementary education at the public schools of Dundee, and in the year 1779, was sent to the University of St. Andrews, where, in the period of four years, he went through a course of Languages, Science and Philosophy, entitling him to the Degree of Master of Arts, which was afterwards conferred on him. While at this University he was distinguished for his attainments in Mathematics, to the study of which branch of science he had, even at this early period of his life, particularly applied himself, under the able instruction of the Rev. John West, at that time assistant to the Professor in the University. It reflects equal credit upon the pupil and the instructor, that for this gentleman Mr. Ivory ever after entertained the highest regard.

Being intended for the Church of Scotland, he now commenced his studies in theology, and in the prosecution of them remained two years at St. Andrews, after the completion of his course of Philosophy. He then removed to the University of Edinburgh; and it is not a little remarkable that he should have done so with Leslie, who had been his fellow-student at St. Andrews. At Edinburgh, he received his third year's theological instruction, necessary, by the regulations of the Scottish church, to qualify him for admission as a clergyman. His studies in divinity were not, however, prosecuted farther; for immediately on leaving the University of Edinburgh, he was, in 1786, appointed assistant-teacher in an academy then instituted in his native town of Dundee, for the purpose of instruction in mathematics and natural philosophy. Having remained in this situation three years, he entered upon a totally different career, becoming a partner in, and the manager of a Flax-spinning Company, which had its mills at Douglastown in Forfarshire, and which assumed the name of James Ivory and Company.

Though now engaged in commercial and manufacturing pursuits, Mr. Ivory still devoted every moment of leisure to his favourite object, the prosecution of mathematical investigations. Living in a secluded part of the country, he was debarred from the advantages of access to libraries and the society of men of science, which a more favoured locality might have afforded him; but this obstacle to the enlargement of his knowledge was overcome by the force of his genius and his powers of application. With a sound knowledge of the geometry of the ancient and of the modern mathematics of his own country, he had already possessed himself of the methods and discoveries of the continental mathematicians, at that time almost wholly unknown in Britain; and he early led the way in that path which he afterwards followed with unrivalled success.

* An excellent account of the life and writings of Sir Charles Bell will be found in Pettigrew's Medical Portrait Gallery, vol. iii.

His earliest memoir, read before the Royal Society of Edinburgh, on the 7th of November 1796, and published in its Transactions, shows, not only that at this time he was well acquainted with the works, and possessed the methods of the most celebrated of the continental writers, but that he could advance independently in the track which they had discovered and so successfully pursued. This memoir, entitled "A New Series for the Rectification of the Ellipse, together with some Observations on the Evolution of the Formula $(a^2 + b^2 - 2ab \cos \phi)^n$," besides displaying considerable analytical skill in the accomplishment of its immediate object, shows that the solution of the highest class of physical problems had already engaged the author's attention.

Two other memoirs, communicated by Mr. Ivory to the same Society, one in 1799, "A New Method of resolving Cubic Equations," and the other in 1802, "A New and Universal Solution of Kepler's Problem," both indicate great originality of thought and powers of investigation. The approximation which he gives in the latter memoir for the determination of the excentric anomaly is remarkable for its simplicity, universality, and accuracy.

At this period, Mr. Ivory was in correspondence with Professor Playfair, Mr. Leslie (afterwards Sir John Leslie), Mr. Wallace and Mr. Brougham (now Lord Brougham), and with these eminent persons his intercourse was ever after continued until interrupted by the death of one of the parties. To the well-founded recommendation of Lord Brougham he was indebted for the grant of a pension of £300 per annum, in 1831, by King William IV.

Released from the anxieties of mercantile speculations by the dissolution of the company of which he had been the manager, he, in 1804, applied for, and immediately obtained, one of the Mathematical Professorships in the Royal Military College at Marlow (afterwards removed to Sandhurst). During the time that he was connected with this institution, he acquired the esteem and regard of the authorities of the College, of his colleagues, and of his pupils. In the discharge of his public duty he appears to have been altogether exemplary; and he was universally considered to be one of the best and most successful instructors that had ever been connected with the College.

He now became better known in the scientific world, and while he discharged the important duties of his Professorship to the advantage of the College and the advancement of its character, he communicated to the public many important memoirs on various scientific subjects, which appeared in the Philosophical Transactions, in Leybourn's Mathematical Repository, Maseres's Scriptores Logarithmici, and the Supplement to the sixth edition of the Encyclopædia Britannica.

About the year 1816, his health began to give way under the confinement consequent upon close application to his professorial duties, and devoted attachment to scientific inquiry; and he was compelled by bad health to resign his Professorship. The estimation in which he was held by the authorities of the College cannot

be more conclusively shown than by the fact, that, when disabled by ill health from performing his arduous duties, the Governor and the Commissioners of the College recommended and procured the retiring pension to be given to him, some years before he had completed the period of service which the regulations of the War Office at that time required. He now took up his residence in London, and in this metropolis or its environs he spent the remainder of his days, living always in great retirement.

Disengaged from professional duties, though still suffering in health, he now devoted his whole time and all the energies of his powerful mind to the investigation and elucidation of various mathematical problems of the highest order; and the result of his inquiries were given to the world in numerous elaborate memoirs, many of the most important of which, it is gratifying to reflect, adorn the volumes of our Transactions. It is no less gratifying to feel that this Society was at the time fully alive to the value of these communications, by awarding to their author, on successive occasions, the highest honours in its power to bestow. In 1814, Mr. Ivory received the Copley Medal "for his various Mathematical communications printed in the Philosophical Transactions."

In 1826, one of the Royal Medals was awarded to him "for his Paper on Astronomical Refractions, published in the Philosophical Transactions for the year 1823, and his other valuable papers on Mathematical subjects." And again in 1839, he received one of the Royal Medals "for his Paper on the Theory of Astronomical Refractions, published in the Philosophical Transactions for 1838," which paper was the Bakerian Lecture for the year.

If Mr. Ivory's rank among the mathematicians of his age could be assigned independently of his communications to the Royal Society, he must still occupy a distinguished place, not only among those of his own country, but of Europe. It was, however, by the communications with which he has enriched our Transactions, that he gained the great scientific reputation which he enjoyed, and it is with them also that we are more immediately concerned.

These papers may be classed under eight different heads; for although several of them are closely related in regard to their physical objects, yet the nature of the mathematics employed in them is so different, that we should do injustice to his reputation if we arranged them under one head.

The first of these is the investigation of the attraction of homogeneous ellipsoids of the second order upon points situated within or without them, printed in the Transactions for 1809. This paper contained the celebrated theorem by which the attraction of an ellipsoid on a point exterior to it, is made to depend upon the attraction of another ellipsoid upon another point interior to it; the latter investigation being, as is well known, comparatively easy. The solution of the more difficult case had been reduced to a form nearly equivalent to this by Laplace, but his process was troublesome; that by Mr. Ivory is remarkably simple and elegant. Although this transformation constitutes the most valuable part of the

paper, it would be wrong to omit to state that the developments which it contains, on the investigation of the attraction in the simpler case, are highly ingenious, and exhibit a perfect command of analysis.

The second subject is the criticism upon the method used by Laplace in the third book of the 'Mécanique Céleste,' for the computation of the attraction of spheroids of any form differing little from spheres, and the substitution of a method purely analytical for some of Laplace's operations which are founded on a geometrical consideration. The papers which contain Mr. Ivory's remarks on these subjects are two papers and an appendix in the volume for 1812, and one in that for 1822. The remarks on Laplace's theory adverted to two points. One of these was the faultiness of his reasoning as relates to the evanescence of the attraction of the particles included between the spheroidal and a spherical surface when the attracted particle was brought very near to the surface. The other was a limitation of the generality of Laplace's assumption for the form of the function expressing the distance between the sphere and the spheroid, to a rational function of the coordinates of each point. With regard to the first of these subjects, it seems impossible to deny that Laplace had, in the greater part of his investigation, left the interpretation of his suppositions in some obscurity; and Mr. Ivory has, with remarkable acuteness and analytical skill, exposed the defects of Laplace's investigation on *his* interpretation of the suppositions. Yet we must observe that the limitation expressed by Laplace ("supposons de plus que la sphère touche le sphéroide, &c.") appears to be entirely overlooked by Mr. Ivory, and that this limitation, when its effects are fairly examined, completely removes the objection. As to the second subject, it is, we believe, allowed by Mr. Ivory himself, that there is no failure in the investigation if the function for the distance between the sphere and the spheroid, though not explicitly rational, admits of being expanded in a converging series whose terms are rational; the only case undoubtedly that can ever occur in physical application. The analytical process which Mr. Ivory substituted for a part of Laplace's is extremely beautiful.

To show the estimation in which Mr. Ivory's talents and labours were held by Laplace himself, we may here quote a remark from Sir Humphry Davy's Address in 1826, on the award of the Royal Medal to Mr. Ivory. "I cannot pretend," says our, then, distinguished President, "to give any idea of the mathematical resources displayed in the problems, and which even the most accomplished geometer could not render intelligible by words alone; but I can speak of the testimony given by M. de Laplace himself in their favour. That illustrious person, in a conversation which I had with him some time ago on Mr. Ivory's first four communications, spoke in the highest terms of the manner in which he had treated his subject; one, he said, of the greatest delicacy and difficulty, requiring no ordinary share of profound mathematical knowledge, and no common degree of industry and sagacity in the application of it."

The investigations to which we have just alluded are those upon

which Mr. Ivory's European reputation as a consummate mathematician was principally founded; and deservedly so. It is no small praise, even at the present time, to assert of any mathematician, that he thoroughly understands the remarkable investigations of Laplace applying to the attractions of spheroids; and it would be still greater to assert that he is able to substitute a new, clear, and elegant process, in place of one portion which seems doubtful and indirect. But at the time when these papers were written (1808 and 1811) the merit was vastly greater than it would be now. Very few English mathematicians could then read with ease an investigation written in the notation of the differential calculus; scarcely any could understand a process of partial differentials; and probably not another person in the kingdom besides Mr. Ivory had read that part of the Mécanique Céleste. In acknowledging that Mr. Ivory most justly earned the reputation which he acquired (and our remarks above, detracting from the necessity of his criticism, do not in the least detract from its singular skill and command of mathematics), we must not omit also to acknowledge, that to his example we owe, in no inconsiderable degree, that direction of mathematical study which has enabled England, at last, to compete in the field of mathematical science with the other nations of Europe, to which she was during a long interval inferior.

The third subject is the investigation of the orbits of comets. Mr. Ivory's method, printed in the Transactions for 1814, is founded on the supposition that the orbit is a parabola, and it tests the trial-assumption of the distance of the comet by the well-known expression for the time depending on two radii vectores and the chord joining them. Although the analysis is elegant, there is not much of originality in this process.

The fourth subject is the investigation of atmospheric refraction. The papers relating to this are contained in the volumes for 1823 and 1838. The former of these proceeds solely on the supposition that the temperature of the air (as entering into the factor which connects the density with the elasticity) decreases uniformly for uniform increase of elevation. The investigation is not remarkably different from those of other writers on the theory of astronomical refractions. The latter contains the effects of adding to the expression for the density of the air resulting from the first supposition, a series of terms following a peculiar law which make the expression perfectly general for all laws of temperature, and which at the same time offer great facilities for mathematical treatment. The whole investigation deserves particular notice as a beautiful instance of mathematical skill. Considerable labour was also bestowed by Mr. Ivory, in these papers, on the ascertaining, from the best accredited experiments, of the values of the constants which enter into different parts of the formulæ.

A fifth subject was treated by Mr. Ivory in elaborate papers in our Transactions for 1824, 1831, 1834, and in a portion of a paper in the Transactions for 1839. The object, in these papers, was to show that the method in which the equilibrium of fluid bodies has

been treated by mathematicians is defective, one additional equation being, in Mr. Ivory's views, logically necessary, although he allows that its introduction produces no change of results in the case which he has investigated at great length, namely, that of a homogeneous fluid. The Royal Society have conceived that the acknowledged uncommon abilities of Mr. Ivory, and the great attention which he had given to this particular subject, made it almost imperative on them to afford every facility which their Transactions could give to the elucidation of his views, more especially as the logical foundation of the theory had scarcely been canvassed to the same extent as that of many other physico-mathematical theories. At the same time they think it necessary, in adverting to this particular theory, to remark, that no other mathematician has agreed with Mr. Ivory in the necessity of his new equation.

While Mr. Ivory still had the subject of the equilibrium of fluids in his consideration, the very remarkable discovery was announced, by MM. Jacobi and Liousville, that it is theoretically possible that a homogeneous ellipsoid with three unequal axes, revolving about one of these axes, may be in equilibrium. In a paper in the Transactions for 1838, Mr. Ivory has with great elegance demonstrated this theorem, and has given, with greater detail than its authors had entered on, several statements regarding the limitations of the proportions of the axes. This may be regarded as the sixth subject.

A seventh subject, the Theory of Perturbations, was treated in papers in the Transactions for 1832 and 1833. The first of these is a treatment of the theory of the variation of the elements, giving no new result, but simplified, in the author's opinion, by the introduction of the area described upon the planet's moving orbit. The second relates merely to the expansion of the perturbing function, in which, by departing in some degree from the usual process, Mr. Ivory conceived that he had given greater facilities for the developments to the higher order of excentricities and inclinations.

An eighth subject, which we have reserved for the last, as containing nothing of a physical character, is the Theory of Elliptic Transcendents, treated in the Transactions for 1831. We are not aware that anything important is added to the theory in this paper, although a new form is given to some of the demonstrations.

The great scientific reputation which Mr. Ivory had established by these and other memoirs not communicated to the Royal Society ensured his election into this Society in 1815, and into many of the other Scientific Societies of this country and of the Continent. He was an Honorary Fellow of the Royal Society of Edinburgh, an Honorary Member of the Royal Irish Academy, and of the Cambridge Philosophical Society; Corresponding Member of the Royal Academy of Sciences of the Institute of France, of the Royal Academy of Sciences of Berlin, and of the Royal Society of Göttingen.

In 1831, the Hanoverian Guelphic Order of Knighthood was conferred on him by King William IV., and it was intimated that he might also receive the British Knighthood, but this he declined, as the title would have been inconsistent with his circumstances. He

had, however, as has already been stated, a pension of £300 per annum subsequently conferred on him by His Majesty. In 1839, the University of St. Andrews conferred on him the Degree of Doctor of Laws.

Although his health had been early impaired by his close application to scientific investigation, he never allowed himself to be unoccupied, but was constantly engaged in his researches to the period of his last illness. In the end of last year his health became seriously impaired, and after an illness of several months, but retaining his faculties to the last, he died on the 21st of September of the present year, aged 77. He was never married*.

Aylmer Bourke Lambert, Esq., was born at Bath on the 2nd of February, 1761. He was the son of Edmund Lambert, Esq., of Boyton House, near Heytesbury, and inherited the name of Bourke from his mother, who was the daughter of Viscount Mayo. He

* The contributions of Mr. Ivory to the Philosophical Transactions are the following:—

1. On the Attractions of Homogeneous Ellipsoids. (Phil. Trans. 1809, p. 345.)

2. On the Grounds of the Method which Laplace has given in the second chapter of the third book of his Mécanique Céleste for computing the Attractions of Spheroids of every description. (Ibid. 1812, p. 1.)

3. On the Attractions of an extensive class of Spheroids. (Ibid. 1812, p. 46.)

4. A New Method of deducing a first Approximation to the Orbit of a Comet from three Geocentric Observations. (Ibid. 1814, p. 121.)

5. On the Expansion in a series of the Attraction of a Spheroid. (Ibid. 1822, p. 99.)

6. On the Astronomical Refractions. (Ibid. 1823, p. 409.)

7. On the figure requisite to maintain the Equilibrium of a Homogeneous Fluid Mass that revolves upon an Axis. (Ibid. 1824, p. 85.)

8. On the Equilibrium of Fluids, and the Figure of a Homogeneous Planet in a Fluid State. (Ibid. 1831, p. 109.)

9. On the Theory of the Elliptic Transcendents. (Ibid. 1831, p. 349.)

10. On the Theory of the Perturbations of the Planets. (Ibid. 1832, p. 195.)

11. On the Development of the Disturbing Function, upon which depend the inequalities of the Motions of the Planets, caused by their mutual Attraction. (Ibid. 1833, p. 559.)

12. On the Equilibrium of a Mass of Homogeneous Fluid at liberty. (Ibid. 1834, p. 491.)

13. Of such Ellipsoids consisting of homogeneous matter as are capable of having the resultant of the attraction of the mass upon a particle in the surface, and a centrifugal force caused by revolving about one of the axes, made perpendicular to the surface. (Ibid. 1838, p. 57.)

14. On the Theory of the Astronomical Refractions. (Ibid. 1838, p. 169.)

15. On the Condition of Equilibrium of an Incompressible Fluid, the particles of which are acted upon by Accelerating Forces. (Ibid. 1839, p. 243.)

16. Note of Mr. Ivory, relating to the correcting of an error in a paper printed in the 'Philosophical Transactions' for 1838, pp. 57, &c. (Ibid. 1839, p. 265.)

died at Kew on the 10th of January of the present year, having nearly completed his 81st year. His name appears among the original members of the Linnean Society, and for nearly fifty years he was one of its Vice-Presidents. He became a Fellow of the Royal Society in 1791, and consequently had belonged to it for more than half a century. He was an eminent botanist, and formed a very extensive herbarium, and was at all times anxious to give information to those attached to the same pursuit. He was the author of many papers in the Linnean Transactions, but his most considerable works were two separate publications. One on the genus Cinchona was given to the world in 1797. The other was a description of the genus Pinus,—a truly magnificent work, which originally came before the public in two vols. folio in the year 1803, to which a third vol. was added in 1834.

He married Catherine, daughter of Richard Bowater, Esq., whom he survived some years, and by whom he left no family. He did not furnish any papers to the Transactions of the Royal Society.

Sir Alexander Burnes is undoubtedly one of those whose death will be most lamented by a country that was proud of his eminent qualities, and grateful for his zealous services.

The name of Burnes was already distinguished in the northern portion of our island. It has received a new lustre from one well worthy of his descent from the same family as Scotland's celebrated poet. Sir Alexander was born at Montrose on the 16th of May, 1805. The same town had the honour of his education. He entered on his career of active service as a cadet of the Bombay army in the year 1821. At the early age of twenty he was appointed Persian interpreter to a force of 8000 men assembled under Colonel Napier for the invasion of Sinde. The following year he was appointed Deputy-Assistant-Quarter-Master-General.

He received, in 1827, the thanks of Government for an elaborate statistical report; and the following year, the Government showed itself equally satisfied with a valuable memoir of the eastern mouth of the Indus. This was succeeded by a valuable supplement.

In 1828, Lieut. Burnes applied for permission to visit the country between the Indus and Marwar; but though this plan was approved of by Sir John Malcolm and Sir Henry Pottinger, its execution was delayed. Burnes was appointed the same year Assistant-Quarter-Master-General, and received orders from the Court of Directors to complete a map of Cutch already commenced by him. Shortly after, he was appointed assistant to the political agent in Cutch, and published in the Transactions of the Royal Geographical Society an account of his survey of that country.

In 1830, he was sent with a present of horses from the King of England to Runjeet Singh. He visited Hydrabad, Lahore, Soodiana, and proceeded to Simla to receive further instructions from Lord W. Bentinck.

After travelling into Central Asia, he revisited Bombay in 1833; thence he received orders to return home with his own despatches,

and was received most cordially in England. His travels were now published, and met a most hearty welcome. They were immediately translated into the French and German languages, the best proof of their merit and importance being appreciated in other countries besides his own. He was warmly welcomed by the Royal Asiatic Society; and the French and English Geographical Societies bestowed on him their respective medals.

He enriched the national collection of the British Museum by presenting it with a collection of oriental coins.

After staying a year and a half in Europe, he returned to the East, and on his second arrival in India, he was sent on a mission to Hydrabad, which was entirely successful. The next, and unfortunately the last public duty in which he was employed was in a mission to Cabul, where those political events occurred which occasioned his falling a victim in his country's service at the early age of 36.

Such is a brief statement of the very active life of a man endowed by nature with an extraordinary variety of powers. Personally active and enterprising, he united to the qualities of the accomplished soldier and statesman those of the philologist and philosopher. What might we not have hoped from such a man, if Providence had seen right to prolong his days!

Sir Alexander was of a lively and playful disposition, and most amiable in private life. He was one of the best of sons and kindest of brothers.

George Fitzclarence, Earl of Munster, was born January 29, 1794. He entered the army at an early age, and served in the Peninsular war. He afterwards went to India, where he assiduously and successfully studied the Sanscrit, Arabic, and Persian languages. In 1818 he was entrusted with despatches announcing the conclusion of the Mahratta war; he seized the opportunity of acquiring and imparting additional knowledge, and travelled home by an overland route, publishing an account of his journey. He was created Earl of Munster soon after the accession of his late Majesty, William the Fourth.

Shortly after his return from India, he was elected a Vice-President of the Asiatic Society, and by his personal exertions procured much valuable information on oriental geography and statistics, and on the natural productions of India. He subsequently took a very active part in promoting the Oriental Translation Fund, and also the Society for the publication of Oriental Texts, and the Association formed for the purpose of increasing our knowledge of the countries south of Egypt. For the last fourteen years, he devoted great labour to the collection of materials for the compilation of a military history, and history of the civilization of the Mahommedan nations. Of this elaborate and important work, which was nearly completed, a long and interesting account is given in the Asiatic Journal. It is to be hoped that the friends of Lord Munster will not allow these labours to have been performed in vain.

It is needless for me to add what a severe loss his lordship's death must be to those who are interested in oriental pursuits, and indeed to his country itself, when we reflect on the large empire held by England in the eastern regions of the globe.

Lord Munster married Miss Wyndham in 1819, and has left a family to lament his death. He was elected President of the Asiatic Society only a short time before his decease.

Richard Hussey, Lord Vivian, was educated at Harrow, and entered the army as an ensign in the year 1793. In 1803, he became a major; Lieutenant-Colonel in 1804; and Colonel in 1812. He was promoted to the rank of Major-General in 1814, and Lieutenant-General in 1830. His first active service was under his late Royal Highness the Duke of York in Flanders. Under Sir John Moore, he commanded the 7th Hussars in 1808 and 1809, and a brigade of cavalry from September 1813 to the termination of the Peninsular war. He was present at the battles of Orthes, Nivelle, and Toulouse; and near the latter place was severely wounded. He also partook of the glory of Waterloo.

Lord Vivian represented his native town of Truro in 1820; subsequently, the borough of Windsor; and lastly, the eastern division of Cornwall in Parliament. He was Commander-in-Chief in Ireland from the year 1831 to 1835, when he filled the office of Master-General of the Ordnance under Lord Melbourne. He received a peerage in 1841, and retired from office at the same time as the ministry which he had supported.

Lord Vivian was Colonel of the 1st Guards at the time of his death. He was universally beloved by those who knew him in private life. As an officer, he was accessible to all, and indefatigable in his exertions in the public service, and few have been held in greater esteem by those under their command.

In the performance of his official duties as Master-General of the Ordnance, he evinced a due sense of the importance of science to the national welfare. He zealously forwarded the views of the Royal Society, and of the British Association, for the promotion of Magnetical Science, by the establishment of magnetical observatories. He highly approved of the employment, to a limited extent, and in time of peace, of the officers and soldiers of the Ordnance department in national scientific undertakings, and gave much consideration to the means by which the objects of the joint application of the above-named Societies might be obtained.

He was also the advocate for the Museum of Economic Geology, and an earnest promoter of the Trigonometrical Survey of the British empire.

John Yelloly, M.D., was born in 1773, at Alnwick in Northumberland, and received his early education at a school in that town. He chose medicine as his profession; and at the age of 20, went to Edinburgh, and after going through the usual course of

study in its University, graduated there in 1796. Four years afterwards, he settled in London, and became a Licentiate of the College of Physicians. In 1806, he married Miss Tyssen, heiress to a considerable landed estate; and established himself in Finsbury Square. About this time, also, he was elected Physician to the Aldersgate-street Dispensary; and, in 1817, succeeded Dr. Cooke as Physician to the London Hospital. He became a Fellow of this Society in 1814.

Endowed by nature with great activity of mind, Dr. Yelloly applied himself with indefatigable industry to the acquisition and the extension of medical knowledge. His views were not confined to the narrow circle of his own individual advancement, but, embracing a wider range of utility, they extended not only to the improvement, but also to the general diffusion of science, and to whatever was calculated to raise the character and exalt the dignity of the profession to which he belonged. This liberal public spirit, indeed, was, throughout life, the main spring of his exertions; and one of its principal fruits was the formation, in conjunction with his friend Dr. Marcet, of the Medical and Chirurgical Society of London. The objects contemplated by such an institution were to establish a closer bond of union than had previously existed among the several branches of the medical profession; to collect a comprehensive medical library for their use; to read and discuss medical papers at the evening meetings; to publish a selection of these papers in the form of Transactions; to promote a free interchange of information, and to cultivate liberal and kindly feelings among the members. Many of the most eminent practitioners, both in Medicine and Surgery, were invited to join this new Society, which, from small beginnings, soon increased in numbers and in reputation, so as in the course of a few years to comprise a large portion of the professional rank and talent of the metropolis. It was to the active exertions and persevering zeal of its two founders that this Society was mainly indebted for its early success and its continued prosperity, amidst occasional difficulties with which it had to contend. Dr. Yelloly, in particular, devoted himself to its welfare with the attachment of a parent. At its commencement he officiated as Secretary, in conjunction with Mr. Charles Aikin; and for many years he was scarcely ever absent from its meetings, taking a lively interest in all its proceedings, and an active part in the discussions of the evening. To its Transactions he contributed many valuable memoirs*. At a later period, about

* These contributions were the following:—

1. A case of tumour in the brain, with remarks on the propagation of nervous influence. (November 29, 1808. Medico-Chirurgical Transactions, vol. i. p. 181.)

2. History of a case of Anæsthesia. (March 11, 1812. Ibid. vol. iii. p. 90.)

3. Observations on the vascular appearance in the human stomach, which is frequently mistaken for inflammation of that organ. (July 24, 1813. Ibid. vol. iv. p. 371.)

4. Particulars of a case in which a very large calculus was removed from the urethra of a female without operation; with examples of analogous cases. (June 20, 1815. Ibid. vol. vi. p. 574.)

the year 1814, under the presidency of Sir Henry Halford, Dr. Yelloly, Dr. Marcet, and other influential members, conceiving that great advantages would result to the Society, and its permanence be better secured, by its being incorporated under a Royal Charter, took the proper measures for accomplishing this object. The necessary forms were gone through, and the grant was on the eve of being signed, when an unexpected opposition was suddenly raised by the College of Physicians, who finally prevailed on the Privy Council to refuse the prayer of the petitioners. Dr. Yelloly, however, lived to see the great change which has since taken place in the spirit of the times; for, in the year 1834, his favourite scheme was realised, all opposition had subsided, and the Society obtained at once from the Crown the Charter under which it is now constituted as the Royal Medical and Chirurgical Society of London.

Although Dr. Yelloly diligently availed himself of the extensive opportunities afforded by his public appointments, and had acquired universal respect and esteem by the suavity of his manners and the kindness of his disposition, it is remarkable that he nevertheless failed to obtain more than a very moderate share of private practice. In course of time his family had become very numerous, while his professional income was by no means increasing in an equal ratio; and prudential motives prevailing over his attachment to the metropolis, he at length determined to quit London, and establish himself at Carrow Abbey, in the immediate vicinity of Norwich. He resided there during many years, engaged in practice: he was soon elected one of the Physicians of the Norfolk and Norwich Hospital, and introduced into that establishment many useful reforms. It was during this period that he undertook the examination of the urinary calculi, of which the Hospital contained a large collection. He communicated to the Royal Society the result of his labours in a paper which was published in the volume of our Transactions for 1829*. In this paper he gives an account of the structure and chemical composition of 330 calculi, which had either been purposely divided or accidentally broken in their extraction. The results are arranged in tables, exhibiting, in the order of their superposition from the centre, the consecutive deposits of which each calculus is composed. It appears from these tables, that not less than two-thirds of all urinary calculi consist of the lithates, or have those substances for their nuclei: whence Dr. Yelloly inferred the probability that a large proportion of them owe their existence to the previous formation of such a nucleus, and was led to suspect that carbonate of lime, although

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5. Case of preternatural growth in the lining membrane covering the trunks of the vessels proceeding from the arch of the aorta. (July 8, 1823. Ibid. vol. xii. p. 565.)

6. Observations on the statement made by Dr. Douglass, of Cheselden's improved lateral operation of lithotomy; in a letter to Sir Astley Cooper, Bart., F.R.S. (April 14, 1829. Ibid. vol. xv. p. 339.)

7. Observations on vascular appearances of mucous and serous membranes, as indicative of inflammation. (Ibid. vol. xx. p. 1.)

* p. 55.

rarely found in a separate form in calculi, is not an unfrequent concomitant of phosphate of lime. With the assistance of Dr. Prout and Mr. Faraday, he ascertained the presence of carbonate of lime in some of the specimens which were not previously supposed to contain it; a result which was confirmed by the analysis of several calculi from the collection of the Hunterian Museum, and also from the Museum of Guy's Hospital.

He presented to the Society, two years afterwards, a sequel to this paper, recording, in a tabular form, the analysis of 335 additional specimens, which had, in the interval, been divided*. The most remarkable fact noticed in this memoir, is the presence of silex in a few specimens. Dr. Yelloly finds reason to believe that the average number of calculous disorders occurring in Scotland has been much underrated; that, on the other hand, the proneness to these complaints is very small in Ireland; and that, on the whole, a much larger proportion of calculous cases occurs in towns than in the country.

For some years before his death, Dr. Yelloly had relinquished practice, and resided at Woodton Hall, near Bungay; his attention being chiefly turned to agricultural pursuits. From thence he removed, about two years ago, to Cavendish Hall, in the neighbourhood of Clare, in Suffolk; where, in February last, his valuable life was suddenly terminated by an attack of apoplexy, while taking an airing in his carriage.

The Earl of Macclesfield was born on the 24th of February, 1755. He married, 25th of May 1780, Mary Frances, daughter and coheir of the Rev. Thomas Drake, and died last March at the advanced age of eighty-seven. He was Lord Lieutenant of the county of Oxford. In former times he used often to attend the meetings of the Royal Society; to which, indeed, it was natural that he should feel something of an hereditary regard, descended as he was from one of our former Presidents.

Among those Fellows whose loss by death this Society has to deplore since my last annual address, Mr. Gage Rokewode should not be forgotten.

This gentleman, long so well known for the admirable manner in which he discharged the duties of Director of the Society of Antiquaries, was the youngest son of Sir Thomas Gage of Hengrave, in Suffolk, the sixth Baronet of that ancient family.

If this were a fit place from which to pronounce an eulogium on private worth of the highest order, the memory of no one could deserve it better, and to his friends (and no one had more) the loss is irreparable. But to the public also the loss is most considerable, and to this more particularly it is my duty to refer.

At an early period of his life he evinced an attachment to the study of those antiquities for the knowledge of which he afterwards became so eminent. I need but refer to the pages of the 'Archæo-

* Phil. Trans. for 1831, p. 415.

logia' and 'Vetusta Monumenta' for proofs of his varied learning, his indefatigable zeal and industry, and his careful accuracy on every one of the many subjects which he touched. His last and perhaps one of his most valuable communications to the Society of Antiquaries, of which he was one of the brightest ornaments (I allude to his paper on the Painted Chamber at Westminster), was completed just before his death. I must not omit to refer also to those beautiful works, in which he so carefully and ably illustrated the history of the ancient and curious seat of his own family, Hengrave Hall, and that portion of Suffolk in which it is situated. Throughout all these varied and laborious pursuits, he displayed not only all the qualifications of a most able and careful antiquary, but also a disposition the most kind-hearted, and a tone of mind the most courteous towards the opinions and feelings of others, as well when differing from them in opinion, as when compelled to notice their errors in the same path of antiquarian learning.

Much as he had done, how much more might not yet have been expected from the labours of one so gifted, had not his life been suddenly and unexpectedly brought to a close!

Lieutenant Wellstead, of the Indian Navy, was a distinguished traveller in the East. He was the author of a notice on the ruins of Berenice, of a journey into the interior of Oman, and of a journey to the ruins of Nahab el Hajar, published in the Transactions of the Royal Geographical Society. He died in the month of October last. He received a severe injury on the head while in India, which was the remote cause of his early and lamented death.

Mr. Hennell, the chemical operator at Apothecaries' Hall, lost his life by an extraordinary accident; he was mixing a large quantity of fulminating mercury for the service of the army in India, and being desirous that it should be of an uniform colour, the whole was placed in a large evaporating dish; as he was stirring it, an explosion of the whole took place, which was attended with his complete destruction, many parts of the body being thrown to a considerable distance. He was an eminent chemist, and had furnished two papers to our Transactions.

It is now, Gentlemen, time for me to perform the most agreeable part of the duty which falls to the lot of a President on your Anniversary—that of giving the Medals awarded by the Council. As we have not the pleasure of seeing here today Mr. MacCullagh, I shall beg Mr. Wheatstone, as his friend, to transmit his Medal to that gentleman.

Mr. Wheatstone.

It gives me great satisfaction to be the organ of the Council of the Royal Society in bestowing on your friend Mr. MacCullagh the Copley Medal. It is needless for me to dilate on the profound mathematical skill and exemplary diligence with which he has explained

the laws of the undulatory theory of light. Philosophers more able than myself to appreciate their merits, have given their testimony to the great value of his discoveries, and to the elegant means that he has employed. It is the sincere wish of us all, that these labours may be followed by others as important to science and as honourable to the University of Dublin; an University that numbers Mr. MacCullagh among the most eminent of her sons.

The Council have awarded the Copley Medal for the present year to Professor MacCullagh, for his researches connected with the wave-theory of light, contained in the Transactions of the Royal Irish Academy. The grounds on which they have made this award are the following. One of the most important steps made in the physical theory of light, since it was first promulgated by Huygens, is, undoubtedly, Fresnel's discovery of the laws of refraction by crystallized media, embodied in his 'Mémoire sur la double réfraction.' The object proposed by Professor MacCullagh, in his first paper *, was to simplify and to develope that theory. He has shown in this paper, that the elastic force of the luminiferous æther may be represented, in magnitude and direction, by means of an ellipsoid, whose semiaxes are the three principal refractive indices of the medium; and he has thence deduced, in a geometrical form, the leading results of Fresnel's theory. This ellipsoid is closely related to the generating ellipsoid of Fresnel; and by the aid of these relations, Professor MacCullagh has demonstrated, in a very simple manner, the truth of Fresnel's construction of the wave-surface, the demonstration of which had been left imperfect by its author.

In Mr. MacCullagh's next paper, entitled "Geometrical propositions applied to the Wave-theory of Light†," he has examined the properties of a surface, which he calls the *surface of indices*, and which had presented itself likewise in the researches of M. Cauchy and Sir William Hamilton; and he has shown that it affords a general and exact construction for the *interval of retardation* of the two rays in their passage through a double-refracting crystal; and thus that the forms of the rings, or isochromatic curves, which had previously been deduced only by approximate methods, may be determined generally.

The next paper of Professor MacCullagh is that "On the Double Refraction of Quartz ‡;" a subject which had engaged the attention, successively, of Biot, Fresnel, and Airy. The first of these writers had determined experimentally the laws of rotatory polarization, which take place when a ray is transmitted along the axis of rock-crystal; and the second had shown that these laws were explained by the interference of *two circularly polarized* rays, which are transmitted *along the axis* with different velocities. The next step in this curious subject was made by Mr. Airy, who examined the peculiar phenomena of refraction by quartz in *other directions*, and showed that they were accounted for by the supposition of two *elliptically polarized* rays, the ratio of the axes of these elliptical vibrations va-

* Transactions of the Royal Irish Academy, vol. xvi.
† Ibid. vol. xvii. ‡ Ibid.

rying with the inclination of the rays to the axis of the crystal. Lastly, Professor MacCullagh has shown that both the circular polarization of the rays in the axis, and the elliptical polarization of the rays inclined to it, may be explained by a certain assumed form of the differential equations of vibratory movement, which not only links together the two classes of phenomena, but also affords a mathematical expression for their laws. The general theory, to be alluded to presently, has enabled him to explain the origin of these assumed forms of the differential equations.

The theory of reflexion at the surfaces of uncrystallized media had been given by Fresnel, although apparently on erroneous principles. The more complex case of reflexion at the surfaces of crystals was left by him to his successors; and the discovery was made independently, and nearly at the same time, by Professor MacCullagh* and M. Newmann of Königsberg. The discovery is not only important in itself, as bringing within the domain of the wave-theory a large class of hitherto unexplained phenomena, but perhaps still more on account of the physical principles upon which it is based, and the constitution of the luminiferous æther which it renders probable. Thus, it is assumed in this theory, in opposition to the hypothesis of Fresnel, that the *vibrations are parallel to the plane of polarization*, and that the *density of the æther is the same in all media*. These, together with the law of the *vis viva*, and the beautiful principle of the *equivalence of vibrations* (but half perceived by Fresnel), form the foundation of the theory of crystalline reflexion, and derive the highest probability from its accordance with phenomena. The results of the theory are embodied in geometrical constructions of great elegance, which determine generally the plane of polarization of the reflected ray, and the amplitudes of the reflected and refracted vibrations.

Hitherto the laws of reflexion at the separating surface of two media were apparently unconnected with those which govern the propagation of light in the same medium. It remained to connect these laws as parts of one and the same system, and to trace the hypothetical principles upon which each theory was based, up to some higher mechanical principle. This crowning point of the theory has been attained by Professor MacCullagh†. Employing the general processes of analytical mechanics, as laid down by Lagrange‡, and limiting the general theorems solely by the conditions that the density of the æther is *constant*, and that the vibrations are *transversal*, he

* "On the laws of crystalline reflexion and refraction." Transactions of the Royal Irish Academy, vol. xviii. This memoir has been honoured by the Medal of the Royal Irish Academy.

† Proceedings of the Royal Irish Academy for December 1839. The complete paper has not yet been published.

‡ Mr. Green appears to have been the first to apply these methods to the dynamics of light, in a paper on the laws of reflexion and refraction at the surfaces of uncrystallized media, published in the Cambridge Transactions. He has failed, however, in assigning the form of the principal function, and has consequently been led to erroneous results.

has succeeded in deducing, as parts of one and the same general theory, not only the laws of propagation in the same medium, previously discovered by Fresnel, but also the laws of reflexion which take place at the bounding surface of any two media, already discovered by himself and M. Newmann. The same theory has likewise led to the *demonstration* of those physical principles, which had been *assumed* in the former paper. It has shown that the *vis viva* is necessarily preserved, in the passage of light from one medium into another; that the resultants of the vibrations are the *same in the two media*; and finally, that the vibrations themselves are *parallel to the plane of polarization*.

This seems to be the most advanced point to which the physical theory of light, in its present form, is capable of being pushed; and it is only by the addition of *new physical principles*, and further insight into the constitution of the luminiferous medium, that any ulterior progress can be expected.

Mr. Fox Talbot.

The many important discoveries made by you in Photography, discoveries to which I have adverted when addressing the Society on another occasion, discoveries which seem, with those of an analogous nature made by a Neipse and a Daguerre, to open to us the vista of discoveries still more vast and curious, undoubtedly well entitle you to the honour of the Rumford Medal at our hands. Your papers, indeed, have been so great an ornament to our volumes, that we can never sufficiently express our thanks to you for them. I trust that you will not desert so promising a line of inquiry, and that our Transactions may receive from you still greater acquisitions of knowledge in the path which is traced by light itself.

Mr. Bowman.

It must be always satisfactory for a President of the Royal Society to present to one of your profession a Royal Medal for labours which have as their instruments, the assiduous application of the noblest faculties of reason—as their immediate purpose, the knowledge of the sublime truths contained in the wonderful adaptations of the organs of created beings—and as their ultimate end, the cure of disease, the alleviation of agony, and the prolongation of human life. Gentlemen of your own valuable profession have given their testimony to the importance of your discoveries, and the Council feels pleasure in rewarding your zeal and talents. To you, and all who, like you, are employed in these noble pursuits, all here will say with me, may God prosper your labours to His glory and to the happiness of His creatures.

Mr. Daniell.

The continued intercourse that I have had with you in the Council of the Royal Society increases the pleasure which I experience in giving into your hands this Medal. Electrical Chemistry, at all times of great importance as giving us an insight into the most recondite laws of nature, has now acquired additional interest by the

practical purposes to which a Wheatstone, a Spencer, a Jacobi, and others have applied it. Its connection with magnetism seems to promise still greater discoveries than those that have already immortalised a Davy and a Faraday. You have pursued this difficult branch of Chemistry with signal success, and the Council have approved of the recommendation of the Chemical Committee, that one of the Royal Medals should be conferred on you for the valuable papers which you have contributed to our Transactions. I trust that our future volumes may be still more enriched by the result of your scientific labours.

The Statutes relating to the election of Council and Officers having been read, and Joseph Smith, Esq., and Alfred Smee, Esq., having, with the consent of the Society, been nominated Scrutators in examining the lists, the votes of the Fellows present were collected.

Dr. Roget, on the part of the Scrutators, reported the following Gentlemen as being duly elected Officers and Council for the ensuing year, viz:—

President.—The Marquis of Northampton.

Treasurer.—Sir John William Lubbock, Bart., M.A.

Secretaries. { Peter Mark Roget, M.D.
Samuel Hunter Christie, Esq., M.A.

Foreign Secretary.—John Frederic Daniell, Esq.

Other Members of the Council.—George Biddell Airy, Esq., M.A., A.R.; Francis Baily, Esq.; Martin Barry, M.D.; Henry James Brooke, Esq.; Robert Brown, Esq., D.C.L.; Rev. James Cumming, M.A.; John Thomas Graves, Esq., M.A.; Sir William J. Hooker, K.H., LL.D.; Robert Lee, M.D.; Gideon A. Mantell, Esq., LL.D.; William Hallows Miller, Esq., M.A.; William H. Pepys, Esq.; George Rennie, Esq.; The Earl of Rosse; William Henry Fox Talbot, Esq.; Charles Wheatstone, Esq.

The thanks of the Meeting were given to the Scrutators for their trouble in examining the lists.

The following is the statement of the Receipts and Payments of the Society during the preceding year, which was laid on the table by the Treasurer:—

Statement of the Receipts and Payments of the Royal Society between Nov. 29, 1841, and Nov. 29, 1842.

RECEIPTS.

				£	s.	d.
Balance in the hands of the Treasurer at the last Audit ..				609	2	8
24 Weekly Contributions, at one shilling	62	8	0			
221 Quarterly Contributions at £1..........	848	0	0			
				910	8	0
20 Admission Fees				200	0	0
4 Compositions for Annual Payments at £40				160	0	0
Carried forward				1879	10	8

	£	s.	d.	£	s.	d.
Brought forward				1879	10	8
5 Compositions for Annual Payments at £60.				300	0	0
Received of Wm. A. A. White, Esq., F.R.S., for Donation Fund				10	0	0
Received of Messrs. Ranking for sums paid on account of the Pacha of Egypt				312	3	0
August 10, Received of Messrs. Ranking on account of the Magnetic Observatory of Egypt, being Allan and Co's. account for Books				33	6	0
Rents :—						
One year's rent of estate at Mablethorpe: due at Michaelmas 1842	88	14	3			
One year's rent of lands at Acton: due at Michaelmas 1842	70	0	0			
One year's fee-farm rent of lands in Sussex; land-tax deducted: due at Michaelmas 1842	19	4	0			
One-fifth of the clear rent of an estate at Lambeth Hill, from the Royal College of Physicians, in pursuance of Lady Sadleir's will: due at Midsummer 1842	3	0	0			
				180	18	3
Dividends on Stock :—						
One year's dividend on £14,000 Reduced 3 per cent. Annuities	420	0	0			
Less Income Tax	6	2	6			
				413	17	6
One year's dividend on 3452*l.* 1*s.* 1*d.* Consols, the produce of the sale of the premises in Coleman-street	103	11	2			
Less Income Tax	1	10	2			
				102	1	0
One year's dividend on £200 Consols	6	0	0			
Less Income Tax	0	1	9			
				5	18	3
Donation Fund.						
Half year's dividend on. . . . £4544 16 9	68	3	5			
Ditto ditto on. . . . 4843 14 7	72	13	1			
	140	16	6			
Less half year's Income Tax. .	2	2	5			
				138	14	1
Rumford Fund.						
One year's dividend on 2292*l.* 11*s.* 7*d.* Consols	68	15	6			
Less Income Tax	1	0	0			
				67	15	6
Carried forward				3444	4	3

	£	s.	d.	£	s.	d.
Brought forward . . .				3444	4	3
Fairchild Fund.						
One year's dividend on £100 New South Sea Annuities	3	0	0			
Sir Clifton Wintringham's Bequest.						
1842. Six years' dividends on 1200*l*.......	216	0	0			
July Half year's dividend on ditto £18 0 0						
Less Income Tax 0 10 6						
	17	9	6			
				236	9	6
Miscellaneous Receipts:—						
Sale of Philosophical Transactions, Abstracts of Papers, and Catalogues of the Royal Society's Library				272	2	1
Sale of 4 Scientific Catalogues to Subscribers and 2 old Catalogues				2	5	0
Credited by Bankers unknown				4	0	0
Total Receipts				£3959	0	10

PAYMENTS.

	£	s.	d.	£	s.	d.
Fairchild Lecture.—The Rev. J. J. Ellis, for delivering the Fairchild Lecture for 1842				3	0	0
Bakerian Lecture.—James D. Forbes, Esq., for the Bakerian Lecture for 1842				4	0	0
Rumford Fund.—Mr. Wyon, for Gold and Silver Rumford Medals				64	0	0
Ditto, for Six Copley Medals				32	2	0
Donation Fund.—Dollond, for Telescope for Sir David Brewster				53	6	0
By purchase of £298 17*s.* 10*d.* 3 per Cent. Consols ..				266	15	3
Books purchased:						
Bailliere: for purchase of Books at Audouin's Sale	105	17	3			
Nutt: for Books	13	3	4			
Stibbs: for ditto	4	10	0			
Simpkin and Co., for ditto	5	17	6			
Maynard: for ditto	9	1	6			
				138	9	7
Carried forward . . .				561	12	10

	£	s.	d.	£	s.	d.
Brought forward . . .				561	12	10
Allan and Co. :—						
For Books for the Magnetic Observatory of Egypt.				33	6	0
Mr. Amyot, Treasurer of the Society of Antiquaries:						
The moiety of the Expenses for repairing the Lamps on Staircase				7	1	9
Salaries :—						
Dr. Roget, one year, as Secretary	105	0	0			
S. H. Christie, Esq., one year, as Secretary. .	105	0	0			
Ditto for Index to Phil. Trans.	5	5	0			
John F. Daniell, Esq., one year, as For. Sec.	20	0	0			
Mr. Roberton, one year, as Assistant-Secretary	200	0	0			
Mr. W. E. Shuckard, one year, as Librarian. .	50	0	0			
G. Holtzer, one year, as Porter	30	0	0			
Ditto, for extra Porterage	10	0	0			
				525	5	0
Few, Hamilton and Few, Solicitors:						
Law Expenses	45	11	0			
Ditto, Mablethorpe Tithe Suit, Society's proportion of the Costs of Appeal	110	0	0			
Ditto, ditto, for the Balance of the Costs of the Suit	53	13	3			
				209	4	3
Sir Clifton Wintringham's Bequest:						
Loscombe Suit :—Paid to the Foundling Hospital.	100	0	0			
Ditto, for the Costs of ditto	25	7	6			
Ditto, for the Attorney-General's Costs. . . .	13	14	2			
				139	1	8
Fire Insurance, on the Society's Property				48	8	3
Mrs. Coppard: Gratuity.				10	0	0
Bills :—						
Taylor:						
Printing the Phil. Trans., 1841, part 2 . .	132	15	0			
Ditto, 1842, part 1.	88	13	6			
Ditto, Proceedings, Nos. 49—54; Circulars, Lists of Fellows, Ballot-lists, Statement of Payments, and Minutes of Council; &c. &c.	115	15	6			
				337	4	0
Carried forward . . .				1871	3	9

	£	s.	d.	£	s.	d.
Brought forward . . .				1871	3	9
Bowles and Gardiner:						
For Paper for the Phil. Trans., 1841, part 2, and 1842, part 1				118	15	0
Basire:						
For Engraving and Copper-plate printing for Phil. Trans., 1841, part 2	92	14	3			
Ditto, for 1842, parts 1 and 2, and miscellaneous printing	255	6	3			
				348	0	6
Gyde:						
Boarding and Sewing 800 Parts of Phil. Trans., 1841, part 2	27	5	4			
Ditto, 1842, part 1..........	27	5	4			
				54	10	8
McDonald and Leslie:						
For Pedestal for Mrs. Somerville's Bust....	11	10	0			
Tuckett:						
Bookbinding	68	18	0			
Pouncey and Sons:						
For Stationery	11	12	9			
Saunderson:						
For Shipping Expenses	9	15	1			
Brecknell and Turner:						
Wax Lights, Candles, and Lamp Oil	34	17	0			
Cubitt:						
For Alterations in Library, Lower Library, and Council Room, and repairing and relaying Carpets, &c.	43	5	0			
Clerks: Christmas Fee................	1	1	0			
Arnold:						
For Coals	24	13	0			
Ditto (Porter's yearly allowance)	4	7	0			
Murray:						
For taking Meteorological Observations	7	0	0			
Gwillim:						
Mats, Brushes, Fire-wood, &c.	6	0	1			
Snell:						
New Blinds for Meeting, Council, and President's Rooms, and cleaning Curtains, &c..	33	19	4			
Copeland:						
China for Tea.......................	3	17	0			
				260	15	3
Taxes and Parish Rates:						
Land and Assessed Taxes	21	14	1			
Poor Rate	20	11	4			
Church Rate	5	15	8			
Carried forward . . .	48	1	1	2653	5	2

	£	s.	d.	£	s.	d.
Brought forward . . .	48	1	1	2653	5	2
Rector's Rate......................	1	9	0			
Sewer's Rate......................	2	2	6			
				51	12	7
Petty Charges:						
Mr. May, assisting Mr. Shuckard with Catalogue thirty weeks..................	37	4	2			
Postage and Carriage..................	12	3	9			
Expenses on Foreign Packets, &c.........	12	4	2			
Stamps	0	15	0			
Charwoman's Wages..................	27	6	0			
Ditto, Extra work	2	5	0			
Miscellaneous expenses	14	14	7			
Library and Window-cleaning, &c.	2	7	0			
				108	19	8
Total Payments				£2813	17	5
Total Receipts and Balance				3959	0	10
Balance in the hands of the Treasurer				£1145	3	5

JOHN W. LUBBOCK, *Treas.*

Nov. 29*th*, 1842.

The Balances in hand, now belonging to the several trusts, are as under: viz:—

	£	s.	d.
Donation Fund	95	8	1
Rumford Fund	72	11	0

The following table shows the progress and present state of the Society, with respect to the number of Fellows:—

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2 12s. Annually.	Paying £4 Annually.	Total.
November 1841....	12	46	528	25	216	827
Since elected......	+ 1	+ 4	+ 7	......	+ 13	25
Since compounded	......	......	+ 2	......	− 2	
Since deceased, &c.	......	......	− 20	− 1	− 5	−26
Ejected	......	......	− 1	......	......	−1
November 1842....	13	50	516	24	222	825

Weekly and Quarterly Contributions.

	£	s.	d.		£	s.	d.
1830..............	£363	4	0	1837..............	531	0	0
1831..............	286	0	0	1838..............	599	4	0
1832..............	255	6	0	1839..............	666	16	0
1833..............	283	7	6	1840..............	767	4	0
1834..............	318	18	6	1841..............	815	12	0
1835..............	346	12	6	1842..............	910	8	0
1836..............	495	0	0				

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 56.

December 8, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following papers were read, viz.:—

1. "Observations on the Blood-corpuscles, particularly with reference to opinions expressed and conclusions drawn in papers 'On the Corpuscles of the Blood,' and 'On Fibre,' recently published in the Philosophical Transactions." By T. Wharton Jones, Esq., F.R.S.

The author points out what he considers to be important errors in the series of papers by Dr. Martin Barry, which have lately appeared in the Philosophical Transactions, and are entitled, "*On the Corpuscles of the Blood*," and "*On Fibre*." He alleges that Dr. Barry has generally confounded the colourless corpuscles contained in the blood with the red corpuscles of the same fluid; each of which latter kind consists of a vesicle or cell, with thick walls, but in a collapsed and flattened state, and having therefore a biconcave form, and in consequence of its thick wall being doubled on itself, presenting under the microscope a broad circumferential ring, which is illuminated or shaded differently from the depressed central portion, according to the focal adjustment of the instrument: while the colourless corpuscles, on the other hand, are of a globular shape, strongly refractive of light, and granulated on their surface, and are of less specific gravity and of somewhat larger size than the red corpuscles. The author quotes various passages from Dr. Barry's papers in proof of his assertions, and refers particularly to fig. 23 of his second paper on the corpuscles of the blood. He farther states, that Dr. Barry's description of the appearances of what he terms the red corpuscles, in paragraphs 53, 68, and 76 of his second paper, can, in fact, apply only to the colourless corpuscles: and he observes, that even when Dr. Barry does, at last, in his "Additional Observations," advert to the distinction between the red and the colourless globules, he considers the latter as being merely "the discs" contained in the red globules appearing under an altered state.

The author regards as wholly erroneous the notion which Dr. Barry entertains that a fibre exists in the interior of the blood-cor-

puscle; and that these fibres, after their escape from thence, constitute the fibres which are formed by the consolidation of the fibrin of the *liquor sanguinis*. The beaded aspect presented by the double contour of the thick wall of the red corpuscle when it has been acted upon either by mechanical causes or by chemical reagents, of which the effect is to corrugate the edge, and to bend it alternately in opposite directions, has, in the opinion of the author, given rise to the illusive appearance of an internal, annular fibre. The appearance of flask-like vesicles presented by some of the red corpuscles, with the alleged fibre protruding from their neck, the author ascribes altogether to the effects of decomposition, which has altered the mechanical properties of the corpuscle, and allowed it to be drawn out, like any other viscid matter, into a thread.

In conclusion, he remarks, that if these statements of Dr. Barry should be recognised as fundamental errors in his premises, the whole of the reasonings built upon them must fall to the ground.

2. "Wind Table, from observations taken at the summit of the Rock of Gibraltar." By Colonel George J. Harding. Communicated by Captain Beaufort, R.N., F.R.S., by order of the Lords Commissioners of the Admiralty.

3. "Spermatozoa observed within the Mammiferous Ovum." By Martin Barry, M.D., F.R.S. L. and Ed.

In examining some ova of a rabbit, of twenty-four hours, the author observed a number of spermatozoa in their interior.

December 15, 1842.

FRANCIS BAILY, Esq., V.P., in the Chair.

His Grace the Duke of Norfolk was balloted for and duly elected a Fellow of the Society.

A paper was read, entitled "Experimental Inquiry into the cause of the Ascent and Continued Motion of the Sap; with a new method of preparing plants for physiological investigations." By George Rainey, Esq., M.R.C.S., Communicated by P. M. Roget, M.D., F.R.S.

The ascent of the sap in vegetables has been generally ascribed to a vital contraction either of the vessels or of the cells of the plant: the circumstances of that ascent taking place chiefly at certain seasons of the year, and of the quantity of fluid, and the velocity of its motion being proportional to the development of those parts whose functions are obviously vital, as the leaves and flowers, have been regarded as conclusive against the truth of all theories which professed to explain the phenomenon on purely mechanical principles. The aim of the author, in the present paper, is to show that these

objections are not valid, and to prove, by a series of experiments, that the motion of the sap is totally independent of any vital contractions of the passages which transmit it; that it is wholly a mechanical process, resulting entirely from the operation of endosmose; and that it takes place even through those parts of a plant which have been totally deprived of their vitality.

The lower extremity of a branch of *Valeriana rubra* was placed, soon after being gathered, into a solution of bichloride of mercury. In a few hours a considerable quantity of this solution was absorbed, and the whole plant, which had been previously somewhat shrunk from the evaporation of its moisture, recovered its healthy appearance. On the next day, although the lower portion of the branch had lost its vitality, the leaves and all the parts of the plant into which no bichloride had entered, but only the water of the solution, were perfectly healthy and filled with sap. On each of the following days additional portions of the stem became affected in succession; but the unaffected parts still preserved their healthy appearance, and the flowers and leaves developed themselves as if the plant had vegetated in pure water and the whole stem had been in its natural healthy state. On a minute examination it was found that calomel, in the form of a white substance, had been deposited on the internal surface of the cuticle; but no bichloride of mercury could be detected in those parts which had retained their vitality; thus showing that the solution of the bichloride had been decomposed into chlorine, calomel, and water, and had destroyed the vitality of the parts where this action had taken place; after which, fresh portions of the solution had passed through the substance of the poisoned parts, as if they had been inorganic canals. Various experiments of a similar kind were made on other plants, and the same conclusions were deduced from them.

As the addition of a solution of iodide of potassium converts the bichloride of mercury into an insoluble biniodide, the author was enabled, by the application of this test to thin sections of the stems of plants into which the bichloride had been received by absorption, to ascertain, with the aid of the microscope, the particular portion of the structure into which the latter had penetrated. The result of his observations was, that the biniodide is found only in the intercellular and intervascular spaces, none appearing to be contained within the cavities of either cells or vessels.

As the fluids contained in the vessels and in the cells hold in solution various vegetable compounds, their density is greater than the ascending sap, which is external to them, and from which they are separated by an intervening organized membrane. Such being the conditions requisite for the operation of the principle of endosmose, the author infers that such a principle is constantly in action in living plants; and that it is the cause of the continual transmission of fluids from the intervascular and intercellular spaces into the interior of the vessels and cells, and also of the ascent of the sap.

December 22, 1842.

GEORGE RENNIE, Esq., V.P., in the Chair.

Augustin F. B. Creuze, Esq., and Captain Samuel F. Widdrington, R.N., were balloted for and duly elected Fellows of the Society.

A paper was in part read, entitled "On the Nerves:" by James Stark, M.D., F.R.S.E. Communicated by James F. W. Johnston, Esq., F.R.S., Professor of Chemistry in the University of Durham.

The Society then adjourned over the Christmas recess, to meet again on the 12th of January next.

January 12, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. The reading of a paper, entitled "On the Nerves," by James Stark, M.D., was resumed and concluded.

The author gives the results of his examinations, both microscopical and chemical, of the structure and composition of the nerves; and concludes that they consist, in their whole extent, of a congeries of membranous tubes, cylindrical in their form, placed parallel to one another, and united into fasciculi of various sizes; but that neither these fasciculi nor the individual tubes are enveloped by any filamentous tissue; that these tubular membranes are composed of extremely minute filaments, placed in a strictly longitudinal direction, in exact parallelism with each other, and consisting of granules of the same kind as those which form the basis of all the solid structures of the body; and that the matter which fills the tubes is of an oily nature, differing in no essential respect from butter, or soft fat; and remaining of a fluid consistence during the life of the animal, or while it retains its natural temperature, but becoming granular or solid when the animal dies, or its temperature is much reduced. As oily substances are well known to be non-conductors of electricity, and as the nerves have been shown by the experiments of Bischoff to be among the worst possible conductors of this agent, the author contends that the nervous agency can be neither electricity, nor galvanism, nor any property related to those powers; and conceives that the phenomena are best explained on the hypothesis of undulations or vibrations propagated along the course of the tubes which compose the nerves, by the medium of the oily globules they contain. He traces the operation of the various causes which produce sensation, in giving rise to these undulations; and extends the same explanation to the phenomena of voluntary motion, as consisting in undulations, commencing in the brain, as determined by the will, and propagated to the muscles. He corroborates his views by ascribing the effects of cold in diminishing or

destroying both sensibility and the power of voluntary motion, particularly as exemplified in the hybernation of animals, to its mechanical operation of diminishing the fluidity, or producing solidity, in the oily medium by which these powers are exercised.

2. A letter from Prof. Hanson to G. B. Airy, Esq., F.R.S., A.R., was also read, "On a New Method of computing the Perturbations of the Planets whose eccentricities and inclinations are not small." Communicated by G. B. Airy, Esq., F.R.S.

The author announces that he has found a method by which the absolute perturbations of planets for any given time, with any given eccentricity and inclination of the orbit, may be calculated; and he exemplifies his method by applying it to the computation of the perturbations produced by Saturn on the comet of Encke, in every point of its orbit; a problem of which hitherto there existed no solution.

3. A paper was also in part read, entitled "On the minute structure of the Skeletons or hard parts of the Invertebrata." By W. B. Carpenter, M.D. Communicated by the President.

January 19, 1843.

GEORGE RENNIE, Esq., V.P., in the Chair.

John Gould, Esq., Sir Benjamin Heywood, Bart., and Edward Solly, jun., Esq., were balloted for and duly elected Fellows of the Society.

Captain Edward Belcher, R.N., was balloted for, but not elected a Fellow of the Society.

The following papers were read:—

1. "Variation de la Déclinaison et Intensité Horizontale observées à Milan pendant vingt-quatre heures consécutives le 25 et 26 Novembre, et le 21 et 22 Décembre 1842." Par Prof. Carlini, For. Mem. R.S.

2. The reading of a paper, entitled "On the minute structure of the Skeletons or hard parts of Invertebrata," by W. B. Carpenter, M.D., was resumed and concluded.

The present memoir is the first of a series which the author intends to communicate to the Society, and relates only to the Mollusca; and he proposes, hereafter, to extend his inquiries to the skeletons of the Echinodermata, and the various classes of articulated animals. After adverting to the classifications of shells proposed by Mr. Hatchett and Mr. Gray, from the propriety of which he finds reason to dissent, he proceeds to state the results of his microscopic examination of the texture of shells under the several following heads. First, shells having a prismatic cellular structure,

as the Pinna, and which are composed of a multitude of flattened hexagonal calcareous prisms, originally deposited in continuous layers of hexagonal cells, and thus constituting a calcified epithelium, analogous with the enamel of the teeth. Secondly, those consisting of membranous shell-substance, the basis of which, after the removal of its calcareous portion, presents nothing but a membranous film, of greater or less consistence, composed of several layers, but without the appearance of any cellular tissue: this membrane the author regards as being derived from the mantle, of which it was originally a constituent part, by the development of nucleolated cells; and the various corrugations and foldings of which it is susceptible in different species, introducing many diversities into the structure of the shells of this class. Thirdly, shells having a nacreous structure, and exhibiting the phenomena of iridescence; a property which the author ascribes to the plicated form of the membrane of the shell, combined with a secondary series of transverse corrugations. Fourthly, shells exhibiting a tubular structure, formed by cylindrical perforations occurring among the several layers, and varying in diameter from about the 20,000th to the 3500th part of an inch; but measuring on an average about the 6000th part of an inch, and presenting a striking analogy with the dentine or ivory of the teeth. The last sections of the paper relate to the epidermis and the colouring matter of shells.

References are made, in many parts of the paper, to illustrative drawings; which, however, the author has not yet supplied.

January 26, 1843.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair.

The following papers were read, viz.:—

1. "Observations on certain cases of Elliptic Polarization of Light by Reflection," by the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

The author, by way of introduction, passes in review the labours of various inquirers on the subject of the elliptic polarization of light, and notices more particularly those of Sir David Brewster, who first discovered this curious property, as recorded in the Philosophical Transactions for 1830; of Mr. Airy, in the Cambridge Transactions for 1831 and 1832; and of Professor Lloyd, in the Philosophical Transactions for 1840, and in the Reports of the British Association for 1841. He then proceeds to give an account of his own experimental examination of the phenomena of elliptic polarization in the reflection of light from various surfaces, by observing the modifications of the polarized rings under different conditions, both of surface and of incidence, and by endeavouring to ascertain both the existence and amount of ellipticity, as shown by

the dislocation of those rings, and to determine its peculiar character, as indicated by the direction in which the dislocation takes place; the protrusion of the alternate quadrants appearing, in certain cases, in one direction, and in others in the opposite. These observations are reducible to two classes; first, those designed to contribute to the inquiry, what substances possess the property of elliptic polarization, by examining the light reflected from various bodies; and second, those made on certain cases of films of several kinds, including those formed on metals by oxidation or other action upon the metal itself, as well as by extraneous deposition. The author found the general result, in all these cases, to be, that from any one tint to another, through each entire order of tints, the form of the rings in the reflected light undergoes certain regular changes; passing from a dislocation in one direction to that in the opposite, through an intermediate point of no dislocation, or of plane polarization; and thus exhibiting a dark and a bright centred system alternately, as long as the order of tints are preserved pure. These changes in the form of the rings, he observes, are precisely those expressed by successive modifications of Mr. Airy's formula, corresponding to the increments in the retardation which belong to the periodical colours of the films.

The remaining portion of the paper is occupied by a description of the apparatus and mode of conducting the experiments; and of the observations made on mica, on decomposed glass, plumbago, daguerreotype, and other metallic plates, and on the coloured films produced on steel and on copper by the action of heat, and of voltaic electricity. The author gives, in conclusion, an analytical investigation of Mr. Airy's general formula.

2. "Variation of the Magnetic Needle as observed at Washington City, D. C., from $3^h\ 30^m$ July 24th to 3^h July 25th, 1840, inclusive (Göttingen mean time)," by Lieut. Gillies, of the United States Service. Communicated by Samuel Hunter Christie, Esq., Sec. R.S.

February 2, 1843.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair, succeeded by the MARQUIS OF NORTHAMPTON, the President, in the Chair.

John Benjamin Heath, Esq., James MacCullagh, Esq., and George Owen Rees, M.D., were balloted for and duly elected Fellows of the Society.

A paper was read, entitled "Experimental Researches in Electricity:" Eighteenth Series; by Michael Faraday, Esq., D.C.L., F.R.S. Section 25. On the Electricity evolved by the Friction of Water and Steam against other bodies.

The object of the experiments related in this paper, is to trace the source of the electricity which accompanies the issue of steam of high pressure from the vessels in which it is contained. By means of a suitable apparatus, which the author describes and delineates, he found that electricity is never excited by the passage of pure steam, and is manifested only when water is at the same time present; and hence he concludes that it is altogether the effect of the friction of globules of water against the sides of the opening, or against the substances opposed to its passage, as the water is rapidly moved onwards by the current of steam. Accordingly it was found to be increased in quantity by increasing the pressure and impelling force of the steam. The immediate effect of this friction was, in all cases, to render the steam or water positive, and the solids, of whatever nature they might be, negative. In certain circumstances, however, as when a wire is placed in the current of steam at some distance from the orifice whence it has issued, the solid exhibits the positive electricity already acquired by the steam, and of which it is then merely the recipient and the conductor. In like manner, the results may be greatly modified by the shape, the nature, and the temperature of the passages through which the steam is forced. Heat, by preventing the condensation of the steam into water, likewise prevents the evolution of electricity, which again speedily appears by cooling the passages so as to restore the water which is necessary for the production of that effect. The phenomenon of the evolution of electricity in these circumstances is dependent also on the quality of the fluid in motion, more especially in relation to its conducting power. Water will not excite electricity unless it be pure; the addition to it of any soluble salt or acid, even in minute quantity, is sufficient to destroy this property. The addition of oil of turpentine, on the other hand, occasions the development of electricity of an opposite kind to that which is excited by water; and this the author explains by the particles or minute globules of the water having each received a coating of oil in the form of a thin film, so that the friction takes place only between that external film and the solids, along the surface of which the globules are carried. A similar, but a more permanent effect is produced by the presence of olive oil, which is not, like oil of turpentine, subject to rapid dissipation.

Similar results were obtained when a stream of compressed air was substituted for steam in these experiments. When moisture was present, the solid exhibited negative, and the stream of air positive electricity; but when the air was perfectly dry, no electricity of any kind was apparent. The author concludes with an account of some experiments in which dry powders of various kinds were placed in the current of air; the results differed according to the nature of the substances employed, and other circumstances.

February 9, 1843.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair.

The following papers were read, viz.—

1. "Magnetical Term-Observations made at the Observatory at Prague, for September, October, November and December, 1842:" by Professor Kreil. Communicated by S. Hunter Christie, Esq., Sec. R.S.

2. "On the Structure and Mode of Action of the Iris:" by C. R. Hall, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

After reciting the various discordant opinions entertained at different periods by anatomists and physiologists, relative to the structure and actions of the iris, the author proceeds to give an account of his microscopical examination of the texture of this part of the eye, in different animals. He considers the radiated plicæ, which are seen on the uvea in Mammalia, as not being muscular; but he agrees with Dr. Jacob in regarding them as being analogous in structure to the ciliary processes. The white lines and elevations apparent on the anterior surface of the human iris, he supposes to be formed by the ciliary nerves which interlace with one another in the form of a plexus. The iris, he states, is composed of two portions; the first, consisting of a highly vascular tissue, connected by vessels with the choroid, ciliary processes, sclerotica and cornea, and abundantly supplied with nerves, which, in the human iris, appear, in a front view, as thread-like striæ; and which are invested, on both surfaces, by the membrane of the aqueous humour. They are more or less thickly covered with pigment, which, by its varying colour, imparts to the iris on the anterior surface its characteristic hue; and, by its darkness on the posterior surface, renders an otherwise semi-transparent structure perfectly opake. The second component portion of the iris consists of a layer of concentric muscular fibres, which fibres, in Man and Mammalia generally, are situated on the posterior surface of the pupillary portion of the iris; but which in Birds extend much nearer to the ciliary margin, and consequently form a much broader layer. In Fishes and in some Reptiles they do not exist at all.

The author then proceeds to inquire into the bearings which these conclusions may have on the physiology of the iris. He thinks that the phenomena of its motions can receive no satisfactory explanation on the hypothesis of erectility alone, or on that of the antagonism of two sets of muscular fibres; the one for dilating, the other for contracting the pupil. He is convinced that the contraction of the pupil is the effect of muscular action; but does not consider the knowledge we at present possess is sufficient to enable us to determine the nature of the agent by which its dilatation is effected. He, however, throws it out as a conjecture, that this latter action may be the result of an unusual degree of vital contractility, residing

either in the cellular tissue, or in the minute blood-vessels of the iris. It is from elasticity, he believes, that the iris derives its power of accommodation to changes of size, and its tendency to return to its natural state from extremes, either of dilatation or of contraction; but beyond this, elasticity is not concerned in its movements.

February 16, 1843.

GEORGE RENNIE, Esq., V.P., in the Chair.

The following papers were read, viz.—

1. "Tide-Observations at Tahiti:" by Captain Edward Belcher, R.N. Communicated by Captain Beaufort, R.N., F.R.S., &c.

This paper consists of copies of the Tide Journal, registered at the Island of Motuatu, in the Harbour of Papeete, and of a short comparative series made at Point Venus. They were conducted by Mr. McKinley Richardson, Mate. The construction of the tide-gauge is described; and an account is given of the methods of observation, and of the precautions adopted to ensure accuracy. The results are specified in the following letter from the author to Captain Beaufort, which accompanies the paper:—

"Her Majesty's Ship Sulphur, Woolwich, August 2, 1842.

"SIR,—Referring to the Tide Registries, forwarded on my arrival, I beg leave to offer the following general remarks upon the tides at Tahiti.

"In consequence of your very special instructions relative to the determination of the *actual periods* of high water at the Island of Tahiti, the most minute attention was paid to this subject; and as these periods could only be *approximated*, recourse was had to my old method (successfully practised in the Lancashire survey), of deriving them from the Equal-altitude system.

"By a reference to the Tide Registry annexed, it will be found that there are *two distinct periods of high water*, during each interval of twenty-four hours; and that during the seven days preceding, and seven days following the full and change, they are confined between the limits of 10 A.M. and 2^h 30^m P.M., the whole range of interval, by day as well as by night, being about 4^h 27^m.

"Commencing with the seventh day preceding the full moon, viz. the 9th of April, it will be perceived that high water occurs at 10 A.M., this being the greatest A.M. interval from noon; and that on the 16th, at the full moon, it occurs nearly at noon.

"Passing on to the 23rd, it reaches the greatest P.M. limit at 2^h 30^m, and on the 2nd of May again reaches the noon period.

"Between the 23rd and 24th, however, a sudden anomaly presents itself. Throughout the day of the 23rd, the variation of the level does not exceed $2\frac{1}{2}$ inches, and the general motion is observed to be 'irregular.' The time of high water is also the extreme P.M. limit.

"On the 24th we discover that it has suddenly resumed *the most distant* A.M. *period*, viz. 10 A.M., but proceeds regularly to the noon period at the change.

"Although the differences of level do not at full and change exceed 1 foot 4½ inches, still I presume that we have sufficient data to establish the fact,—that it is *not invariably high water at noon* (as asserted by Kotzebue, Beechey and others); and, further, that we have corresponding *nightly periods* of high water.

"It is evident that the time of high water at full and change may be assumed as that of noon, because we have sufficiently decided changes of level to fix the approximate period of high water.

"It does not appear by these Registers, that any higher levels result from the rollers sent in by the strong sea breezes (as asserted by several writers), but rather the contrary, the highest levels being indicated during the night, when the land breezes prevailed.

"I have great satisfaction in presenting you with these facts, and trust that they may induce others to follow up the same experiments, so as, eventually, to obtain the variations which other seasons may produce.

"I am, Sir, your most obedient servant,

"EDWARD BELCHER, *Captain.*"

"*Captain Beaufort, R.N., F.R.S., Hydrographer.*"

2. "On Fissiparous Generation:" by Martin Barry, M.D., F.R.S. L. and Ed.

The author observes that the blood-corpuscle and the germinal vesicle resemble one another in the circumstance of an orifice existing in the centre of the parietal nucleus of both. He pursues the analogy still farther, conceiving that as a substance of some sort is introduced into the ovum through its orifice, which the author terms *the point of fecundation*, so the corpuscles of the blood may undergo a sort of fecundation through their corresponding orifice; and also that the blood-corpuscle, like the germinal vesicle, is propagated by self-division of its nucleus; a mode of propagation which he believes to be common to cells in general. The nucleus of the germinal vesicle, or original parent cell of the ovum, gives origin, by self-division, to two young persistent cells, endowed with qualities resulting from the fecundation of the parent cell; these two cells being formed by assimilation, out of a great number of minuter cells which had been previously formed. This account of the process, which takes place in the reproduction of the entire organism, explains, according to Dr. Barry, the mysterious reappearance of the qualities of both parents in the offspring.

Certain nuclei, which the author has delineated in former papers as being contained within and among the fibres of the tissues, he conceives to be, in like manner, centres of assimilation, from observing that they present the same sort of orifice, that they are reproduced by self-division, and that they are derived from the original cells of development; that is, from the nuclei of the corpuscles of the blood. He considers that assimilation of the substance intro-

duced into the parietal nucleus of the cell is part of the process which propagates the cell; that the mode of reproduction of cells is essentially fissiparous, and that the process of assimilation prepares them for being cleft.

A pellucid point is described by the author as being "contained in a certain part of the cell-wall, and as representing the situation of a highly pellucid substance, originally having little if any colour." This substance, which he considers as being primogenital and formative, he denominates *hyaline*, and ascribes to it the following properties. It appropriates to itself new matter, thus becoming enlarged; then divides and subdivides into globules, each of which passes through changes of the same kind. Under certain circumstances, it exhibits a contractile power, and performs the motions called *molecular*. It is the seat of fecundation, and it is by its successive divisions that properties descend from cell to cell, new properties being continually acquired as new influences are applied; but the original constitution of the hyaline not being lost. The main purpose for which cells are formed is to reproduce the hyaline; and this they do by effecting the assimilation which prepares it to divide; such division being thus the essential part of fissiparous generation.

The remaining part of the paper is occupied with a detailed account of these processes as they occur in the development of the ovum, and also in the changes exhibited by the corpuscles of the blood, in which fissiparous reproduction also takes place, and the red blood-discs are converted into fibrin, and thus give origin to the various tissues of the organs. The same theory of fissiparous reproduction he also applies to the formation of the muscular fibre, in connexion with his belief that it is composed of a double spiral filament. Contractile cilia, he supposes, are also formed by the elongation of nuclei, the filaments proceeding from them in opposite directions. The author considers, lastly, the subject of the fissiparous reproduction of the Infusoria, and particularly of the *Volvox globator*, the *Chlamido-monas*, *Baccillaria*, *Gonium*, and the *Monadina* in general; and applies the same theory to gemmiparous reproduction, and to the so-called spontaneous generation of infusoria and parasitic entozoa.

February 23, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

James Meadows Rendel, Esq., was balloted for, and duly elected a Fellow of the Society.

The following papers were read, viz.—

1. "Researches on the Decomposition and Disintegration of Phosphatic Vesical Calculi; and on the introduction of Chemical

decomponents into the living Bladder." By S. Elliott Hoskins, M.D Communicated by P. M. Roget, M.D., Sec. R.S.

The object of these researches was the discovery of some chemical agent, more energetic in its action on certain varieties of human calculi, and less irritating when injected into the bladder, than any of the fluids hitherto employed.

These indications not being fulfilled by dilute acids, or other solvents which act by the exertion of single elective affinity, the author investigated the effects of complex affinity in producing decomposition, and consequent disintegration, of vesical calculi.

For this purpose an agent is required, the base of which should unite with the acid of the calculus, whilst the acid of the former should combine and form soluble salts with the base of the latter. The combined acids would thereby be set free in definite proportions, to be neutralized in their nascent state, and removed out of the sphere of action, before any stimulating effect could be exerted on the animal tissue.

These intentions the author considers as having been fulfilled by the employment of weak solutions of some of the vegetable supersalts of lead; such as the supermalate, saccharate, lactate, &c. The preparation, however, to which he gives the preference, is an acid saccharate, or, as he calls it, a *nitro-saccharate of lead.*

The salt, whichsoever it may be, must be moistened with a few drops of acetic, or of its own proper acid, previous to solution in water, whereby alone perfect transparency and activity are secured. He furthermore states, that the decomposing liquid should not exceed in strength one grain of the salt to each fluid-ounce of water, as the decomposing effect is in an inverse ratio to its strength.

Having by experiments which are fully detailed ascertained the chemical effects of the above class of decomponents on calculous concretions *out* of the body, the author briefly alludes to the cases of three patients, in each of whom from four to eight ounces of these solutions had been repeatedly, for weeks together, introduced into the bladder, and retained in that organ without inconvenience for the space of from ten to fifty minutes.

It not being the intention of the author to enter into the medical history of these cases, he merely cites the above facts as sufficient to establish the principle originally laid down; namely, chemical decomposition of phosphatic calculi, by means of solutions so mild as to be capable of retention in the living human bladder without irritation or inconvenience.

2. "A Method of proving the three leading properties of the Ellipse and the Hyperbola from a well-known property of the Circle." By Sir Frederick Pollock, Knt., F.R.S., Her Majesty's Attorney General. Communicated in a letter to P. M. Roget, M.D., Secretary to the Royal Society.

In this communication, the author first demonstrates the well-known property of the circle, that if from a point in the diameter produced there be drawn a tangent to the circle, and from the point

of contact there be drawn a line perpendicular to the diameter; and if from any point in the circumference there be drawn two lines, one to the point without the circle, and another to the foot of this perpendicular, the former of these lines will be to the latter, as the distance of the point without the circle from the centre, is to the radius of the circle. By means of this property, and assuming that the ellipse is the curve whose ordinate, at right angles to its axis, is to the corresponding ordinate of the circle, described upon this axis as a diameter, in a constant ratio, the author proves the following propositions relating to this curve:—

1. The rectangle of the abscissæ is to the square of the ordinate, as the square of the semiaxis major to the difference of the squares of the semiaxis major and the excentricity.

2. The distance of any point in the curve from the focus, is to its distance from the directrix, as the excentricity is to the semiaxis major.

3. The sum of the distances of any point in the curve from the two foci is equal to the axis major.

By a method nearly similar to that employed for the ellipse, and assuming that the hyperbola is a curve in which the rectangle of the abscissæ is to the square of the ordinate, as the square of the ordinate in a circle, described upon the axis major as a diameter, is to the square of the subtangent, the author shows, first, that the distance of any point in the curve from the focus is to its distance from the directrix, as the distance between the foci is to the axis major; and secondly, that the difference of the distances of any point in the curve from the two foci is equal to the axis major.

3. "On the diurnal Temperature of the Earth's surface, with the discussion of a simple formula for ascertaining the same." By S. M. Drach, Esq., F.R.A.S. Communicated by John Lee, Esq., LL.D., F.R.S.

The author investigates the several causes which influence the daily temperature of any point at the earth's surface. He employs the term *Thermal establishment* to denote the retardation of the effects of solar light caused by atmospherical conduction and by local circumstances, in the same manner that the term *Tidal establishment* has been used to express the local constant by which the astronomical effects on the waters of the ocean are delayed. After explaining the formation of the tables and diagrams given at the end of the paper, and detailing the conclusions derivable from them, the author enters into a review of the perturbing causes, investigates the analytical expression for the daily heat, and concludes with some observations on isothermal lines, on the influence of the friction resulting from the rotation of the earth about its axis, and on the agency of electricity.

March 2, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. A paper was read, entitled, "On the Laws of Individual Tides at Southampton and at Ipswich." By G. B. Airy, Esq., M.A., F.R.S., Astronomer Royal.

The author gives the results of his own personal observations of the tides at Southampton and at Ipswich, in both of which places they present some remarkable peculiarities. In conducting these inquiries he obtained, through the favour of Colonel Colby, R.E., and Lieut. Yelland, R.E., the able assistance of non-commissioned officers and privates of the corps of Royal Sappers and Miners. He explains in detail the nature of his observations, and the method he pursued in constructing tables of mean results; and deduces from them the conclusion, that the peculiarities in the tides which are the object of his investigation are not dependent on any variations in the state of the atmosphere, but are probably connected with the laws which regulate the course of waves proceeding along canals.

2. A paper was in part read, entitled, "On the Special Function of the Skin." By Robert Willis, M.D. Communicated by John Bostock, M.D., F.R.S.

March 9, 1843.

Sir JOHN WILLIAM LUBBOCK, Bart., V.P. and Treasurer, in the Chair.

John Miers, Esq., was balloted for, and duly elected a Fellow of the Society.

1. The reading of a paper, entitled, "On the Special Function of the Skin." By Robert Willis, M.D. Communicated by John Bostock, M.D., F.R.S., was resumed and concluded.

The purpose which is answered in the animal economy by the cutaneous exhalation has not hitherto been correctly assigned by physiologists: the author believes it to be simply the elimination from the system of a certain quantity of pure water, and he considers that the saline and other ingredients which pass off at the same time by the skin are in too inconsiderable a quantity to deserve being taken into account. He combats by the following arguments the prevailing opinion, that this function is specially designed to reduce or to regulate the animal temperature. It has been clearly shown by the experiments of Delaroche and Berger, that the power which animals may possess of resisting the effects of a surrounding medium of high temperature is far inferior to that which has been commonly ascribed to them; for in chambers heated to 120° or 130° Fahr., the tempe-

rature of animals is soon raised to 11° or even 16° above what it had been previously, and death speedily ensues. The rapid diminution or even total suppression of the cutaneous exhalation, on the other hand, is by no means followed by a rise in the temperature of the body. In general dropsies, which are attended with a remarkable diminution of this secretion, an icy coldness usually pervades both the body and the limbs. A great fall in the animal temperature was found by Fourcauld, Becquerel and Breschet to be the effect of covering the body with a varnish impervious to perspiration; and so serious was the general disturbance of the functions in these circumstances, that death usually ensued in the course of three or four hours.

The question will next arise, how does it happen that health and even life can be so immediately dependent as we find them to be on the elimination of so small a quantity of water as thirty-three ounces from the general surface of the body in the course of twenty-four hours? To this the author answers, that such elimination is important as securing the conditions which are necessary for the endosmotic transference between arteries and veins of the fluids which minister to nutrition and vital endowment. It is admitted by physiologists that the blood, while still contained within its conducting channels, is inert with reference to the body, no particle of which it can either nourish or vivify until that portion of it which has been denominated the *plasma* has transuded from the vessels and arrived in immediate contact with the particle that is to be nourished and vivified: but no physiologist has yet pointed out the efficient cause of these tendencies of the plasma, first, to transude through the wall of its efferent vessels, and secondly, to find its way back again into the afferent conduits. The explanation given by the author is that, in consequence of the out-going current of blood circulating over the entire superficies of the body perpetually losing a quantity of water by the action of the sudoriparous glands, the blood in the returning channels has thereby become more dense and inspissated, and is brought into the condition for absorbing, by endosmosis, the fluid perpetually exuding from the arteries, which are constantly kept on the stretch by the injecting force of the heart.

In an appendix to the paper, the author points out a few of the practical applications of which the above-mentioned theory is susceptible. Interference with the function of the skin, and principally through the agency of cold, he observes, is the admitted cause of the greater number of acute diseases to which mankind, in the temperate regions of the globe, are subject. He who is said to have suffered a chill, has, in fact, suffered a derangement or suppression of the secreting action of his skin, a process which is altogether indispensable to the continuance of life; and a disturbance of the general health follows as a necessary consequence. Animals exposed to the continued action of a hot dry atmosphere die from exhaustion; but when subjected to the effects of a moist atmosphere of a temperature not higher than their own, they perish much more speedily; being

destroyed by the same cause as those which die from covering the body with an impervious glaze; for, in both cases, the conditions required for the access of oxidized, and the removal of deoxidized plasma, are wanting, and life necessarily ceases. The atmosphere of unhealthy tropical climates differs but little from a vapour-bath at a temperature of between 80° and 90° Fahr.; and the dew-point in those countries, as for example on the western coast of Africa, never ranges lower than three or four degrees, nay, is sometimes only a single degree, below the temperature of the air. Placed in an atmosphere so nearly saturated with water, and of such a temperature, man is on the verge of conditions that are incompatible with his existence: conditions which may easily be induced by exposure to fatigue in a humid atmosphere under a burning sun, or other causes which excite the skin while they prevent the exercise of its natural function. The terms *Miasma* and *Malaria* may, according to the author, be regarded as almost synonymous with air at the temperature of from 75° to 85° Fahr., and nearly saturated with moisture.

2. A paper was also read, entitled, "On the Cause of the reduction of Metals from solutions of their salts by the Voltaic circuit." By Alfred Smee, Esq., F.R.S., Surgeon to the Bank of England.

The reduction of a metal from its saline solution by the agency of voltaic electricity, has, the author states, been explained in three different ways. By Hisinger, by Berzelius, and by Faraday it has been ascribed to the liberation of hydrogen in this process: Davy and others considered it as resulting directly from the attraction of the metal to the negative pole: and Daniell conceives that the metal is directly electrolysed by the action of the voltaic circuit. The author found that the ends of copper wires, placed in a solution of sulphate of copper between two platina poles in the circuit, manifest electric polarity; so that while one end is dissolving, the other is receiving deposits of copper: he also found that platina was, in like manner, susceptible of polarity, although in a much less degree than copper, when placed in similar circumstances. With a view to determine the influence of nascent hydrogen in the voltaic reduction of metals, he impregnated pieces of coke and of porous charcoal with hydrogen, by placing them, while in contact with a metal, in an acid solution, when they thus constituted the negative pole of the circuit; and he found that the pieces thus charged readily reduced the metals of solutions into which they were immersed; and thence infers that the hydrogen is the agent in these reductions. From another set of experiments he concludes, that during these decompositions, water is really formed at the negative pole; a circumstance which he conceives is the chief source of the difficulties experienced in electro-metallurgic operations when they are conducted on a large scale, but which may be avoided by a particular mode of arranging the elements of the circuit so as to ensure the uniform diffusion of the salt.

The author obtained the immediate reduction of gold, platina, palladium, copper, silver and tin from their solutions by the agency

of hydrogen contained in a tube, with a piece of platinized platina in contact with the metallic salt: nitric acid and persalts of iron, on the other hand, yielded their oxygen by the influence of the same agent.

The general conclusion which he deduces from his experiments is that, when a metallic solution is subjected to voltaic action, water is decomposed, its oxygen passing in one direction, and its hydrogen in the opposite direction; the latter element performing at the moment of its evolution at the negative pole the same part with respect to a solution of sulphate of copper, that a plate of iron or zinc would perform to the same solution.

March 16, 1843.

FRANCIS BAILY, Esq., V.P., in the Chair.

William Brooke O'Shaughnessy, M.D., was balloted for, and duly elected a Fellow of the Society.

The following papers were read, viz.—

1. "On the import and office of the Lymphatic Vessels." By Robert Willis, M.D. Communicated by John Bostock, M.D., F.R.S.

That absorption is the special office of the lymphatic vessels was, until very lately, a universally received doctrine in physiology: but it is now admitted that if they exercise this faculty, it can be only to an inconsiderable extent; and physiologists of high authority have even denied that they possess any absorbing power at all. This last is the opinion of Magendie, in which the author concurs. So lately as 1841, Rudolph Wagner asserted that "neither anatomical nor physiological considerations render any satisfactory account of the import and office of the lymphatics," which thus, shorn of their ancient office, were repudiated as a superfluous apparatus in the animal mechanism. The grand organs of absorption the author believes to be the veins; and a principal object of his paper is to point out the mode in which they acquire this remarkable faculty. The principal condition which this faculty of imbibition implies, is a difference in density between the contents of the vessels which are to absorb, and the contents of those which furnish the matter to be absorbed. If the several constituent materials of the body, both fluid and solid, were to remain in the same unaltered state, both chemically and physically, there could be no interchange among them: in order that mutual penetration may take place between two elements, the one must differ from the other: that which is designed to absorb must be, with relation to that which is to be absorbed, more dense; that is, must contain a smaller quantity of water in proportion to its solid ingredients. For the continuance of the delicate processes concerned in the access and removal of the nutrient fluids, it is necessary that a difference should be established between the arterial and the venous blood in respect of density. This purpose the author conceives is accomplished by the abstraction from

the former of a portion of its water by the sudoriparous glands of the skin on the one hand, and by the lymphatic vessels on the other.

That the separation of the lymph from the blood is calculated to increase its density, is proved by its chemical analysis; lymph containing from 96 to 97 per cent. of water, and blood from 77 to 82 per cent. The author regards this separation of lymph from the blood as the result of a purely vital process of the same nature as that by which the saliva and the watery portion of the urine are secreted from the circulating mass. He considers that his views are supported by the anatomical distribution of the lymphatic system: for, on the principle that organs are found in the vicinity of the places where their office is wanted, the office of the lyphatics must be general, inasmuch as the system is general. These vessels may, in fact, be regarded as the essential element of an universally distributed gland. The mode in which the lymphatics are finally connected with the blood-vessels appears also to indicate that the object in view is to keep their watery fluid separate from the blood as long as possible; for, as is well known, they do not transfer their contents into the neighbouring veins, but pour their whole fluid into the superior vena cava at the moment it is about to enter into the heart.

The remarkable manner in which the lymphatic system is developed in some of the lower tribes of animals, whose bodies are encased in an impervious horny covering, such as turtles, lizards and serpents, is adduced in further corroboration of the author's views. He regards the serous membranes as contrivances for the accommodation of a great number of lymphatics; and the intimate connexion which the function of these vessels has with the life and nutrition of internal organs he thinks is shown by the remarkable amount of disturbance consequent on inflammation, or other morbid condition of serous membranes. Finally, the author adverts to the influence which the difference of endosmotic capability engendered by the abstraction of a certain amount of water in the course of the circulation, (first between the blood corpuscles and the plasma in which they swim, and then between the liquor sanguinis and the containing channels,) must have on the capillary circulation, which he conceives it is calculated to facilitate.

2. "Further Observations on the descending fluids of Plants, and more especially the Cambium." By George Rainey, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author relates an experiment in proof of the sap descending from the upper to the lower part of an exogenous tree, through vessels which are continuous from the leaves to the roots; the course of these vessels being shown by the addition of a solution of iodide of potassium after they had taken up by absorption a quantity of a solution of acetate of lead. The fluids in these vessels are, he conceives, separated from the sap, which is ascending from the roots, only by the membrane of which they are composed. When the leaf-buds of a tree are vegetating, large separations are observable

between the cells of the bark, and also between the bark and the wood: while no such separations are apparent when the leaf-buds are entirely inactive. These separations are various in size, and irregular in form; their parietes consist of rows of cells, piled up one above another, like the bricks of a wall: and their cavities all communicate with one another. From these and other anatomical facts, which are given in detail by the author, he concludes that the propulsion of the sap along the vessels, resulting from the operation of endosmose, will explain the descent of the cambium, which, being the nutritious portion of the vegetable fluids, corresponds in its nature to the chyle in animals.

March 23, 1843.

GEORGE RENNIE, Esq., V.P., in the Chair.

A paper was read, entitled, "Notice of an Extraordinary Luminous Appearance seen in the Heavens on the 17th of March, 1843," in a Letter to S. H. Christie, Esq., Sec. R.S., by Sir John F. W. Herschel, Bart., F.R.S.

Collingwood, March 17, 1843.

MY DEAR SIR,—This evening, at half-past seven o'clock, I received notice from one of my servants of a luminous appearance in the sky, visible towards the S.W., which I immediately ran out to observe, and which, as it differed in some remarkable particulars from any phenomenon of the kind I have ever before observed or seen described, I think it not unlikely to prove interesting to the Royal Society.

The evening was one of uncommon serenity and beauty: the moon, only thirty-eight hours after the full, having considerable south declination, was not yet risen. In consequence, the sun being already far enough below the horizon to leave only a faint glow of twilight in the west, the stars shone with unsubdued brilliancy, no cloud being visible in any quarter. Orion in particular was seen in all its splendour; and commencing below that constellation, and stretching obliquely westward and downwards, nearly, but not quite to the horizon, was seen the luminous appearance in question. Its general aspect was that of a perfectly straight, narrow band of considerably bright white cloud, thirty degrees in length, and about a degree and a quarter, or a degree and a half in breadth in the middle of its length; its brightness nearly uniform, except towards the ends, where it faded gradually, so that to define its exact termination at either end was difficult. However, by the best judgement I could form, it might be considered as terminating, to the eastward or following side, at, or a very little beyond, the stars ι, κ, λ Leporis, which stars (being of the fifth, or at most 5·4 magnitude) were pretty conspicuously visible; from which circumstance the degree of brightness of the ground of the sky in that region may be well estimated. Between these stars and μ Leporis, the luminous band then com-

menced, involving neither of them, but more nearly contiguous to κ and λ than to μ. From thence its course was towards π Eridani, which star must have been covered by it, and was not seen; this judgement of its direction having been formed by noticing that it passed clearly above γ Eridani, and as clearly below and parallel to the direction of δ, ϵ Eridani, which two stars being dimmed by the vapours of the horizon and the twilight, were so little conspicuous as perfectly to account for π not having been noticed. At the point of its passage between γ and δ it was still considerably bright, and as it terminated with somewhat more abruptness at a point beyond ϵ (then about 12° high) than at its upper extremity, I am rather disposed to consider this end as somewhat curtailed by the vapours. Making no allowance, however, for this, and estimating its visible termination at a point on a celestial globe nearly opposite ζ Eridani (which star however was not noticed at the time), the length above assigned to the luminous band (30°) has been concluded by measurement on the globe.

I am thus particular in describing the course, situation and dimensions of the band, not only as terms of comparison with other observations of it, should any have been made, but for another reason, in which consists the peculiarity of the phenomenon, and which is my sole motive for making this communication. The above situation and course, relatively to those stars, *remained perfectly unaltered the whole time it remained visible at all*, which it did for upwards of an hour from the time I first saw it, *accompanying the stars in their diurnal motion*, until the preceding end at length was extinguished in the horizon vapours with the stars adjacent, and until the light of the rising moon dimmed and at length effaced the rest, though I apprehend its intrinsic lustre to have been in progress of diminution during the last quarter of an hour or twenty minutes.

I should not forget to mention, that neither in the north-west, nor elsewhere, were any streamers or other appearances of Aurora Borealis perceptible during any part of the evening. The only other luminous appearance, the milky way excepted, was that of the zodiacal light, which I have seldom seen to greater advantage in this climate, and which extended high enough to involve the Pleiades, then about 55° from the sun.

I have said that the general aspect of the phenomenon was that of a bright white cloud. In fact, my first impression was that such was its nature; an impression immediately dissipated and ultimately converted into the contrary certainty by the following considerations and observed facts. For, in the first place, no ordinary cloud at such an angular elevation above the horizon could have received from the sun, even at the earliest hour when it was observed, anything like sufficient illumination to have presented so luminous an appearance; that luminary being then between 9° and 10° below the horizon, and the moon not yet being risen, even at eight o'clock, when I judged the light of the band by contrast with the increasing darkness of the ground of the sky to have attained its maximum, at which hour the depression of the sun was nearly 12°.

Moreover, 2ndly, about a quarter of an hour after the band was first observed, being then on the roof of my house and having a very uninterrupted view of the western horizon, I noticed the formation of a small streak of cloud about the same apparent altitude, somewhat to the north of the pyramid of the zodiacal light, and therefore nearer to the place of the sun below the horizon. The direction of this streak was horizontal, not oblique, and its hue black, not white. This cloud enlarged and became projected as a dark space within the zodiacal light, and soon after others of a less defined character formed elsewhere, all, however, without exception, dark instead of luminous.

3rdly. At the rising of the moon, about half-past eight, the light of our band, already probably on the decrease, was almost wholly effaced. On the other hand, by this time numerous lines and cirrous streaks of light cloud which had been for some time in progress of formation, and had been either wholly unseen before or only noticed by their effacing the stars behind them, became illuminated, and appeared as white streaks and patches, such as are usually observed in moonlight nights.

4thly, and lastly. Although the night was very calm, yet on watching narrowly the motions and changes of these real clouds with respect to the stars, they were perceived to *rise very slowly from the west, i. e.* in a direction nearly or quite contrary to that of the declining band.

From these united considerations, and from the extreme fixity of the band among the stars, I consider it impossible to regard it as a cloud illuminated by the sun through the medium of atmospheric refraction. The latter reason, too, is equally conclusive against its being classed with ordinary auroral bands and arcs, which, though they keep their position well enough to be regarded as at rest by a careless observer, yet, when compared with stars, are always perceived to be drifting, as it were, in some certain direction, or otherwise changing in figure and dimension.

If we look to an origin for this phenomenon beyond our atmosphere, we become involved in speculations, which, however interesting, it is not the object of this communication to enter into. On the other hand, its purpose will be answered if either it should be the occasion of eliciting corresponding observations of the same, or notices of similar phenomena already observed, or should lead to increased watchfulness on the part of meteorologists to avail themselves of occasions (which perhaps occur oftener than we are aware) of noting anything analogous in future.

I have the honour to remain,
My dear Sir,
Your very faithful and obedient Servant,
J. F. W. HERSCHEL.

Saturday, March 18, 1843.

P.S.—There having been no post today, and the above not having been finished in time for despatch last night, an opportunity is af-

forded me for stating that the phenomenon above described has again reappeared this evening, at the same hour and in the same situation, or rather a very little more to the north, so as to graze and partly to involve the stars κ, λ Leporis. It was also traceable in R. A. some little way beyond those stars on the following side. The horizon being more obscured by vapour tonight than last night, neither γ, δ, nor ϵ Eridani could be seen.

The fixity of this object among the stars on the 17th, induced me to express to a member of my family this morning an idea that it might possibly be seen again tonight, in which event its extra-atmospheric origin would become quite evident. If a thread be stretched on a celestial globe along the central line of the band as nearly as the above observations will enable us to fix it, and prolonged to meet the ecliptic, *it will strike on the actual place of the sun.* The inference seems almost unavoidable, that our band is no other than the tail of a magnificent comet, whose head at the times of both observations has been below the horizon. I await, therefore, with extreme interest, the event of further observation, but although to afford others an opportunity of observing it, it will be necessary for me to make a more immediate and public announcement, I am still desirous to place on record my first impressions respecting so remarkable an appearance, in the mode originally intended, both as a mark of respect to the Royal Society, and as pointing inquiry to other luminous "streaks" and "columns" in the sky, which have been spoken of to me as having been seen during the last summer and autumn on more than one occasion, and which in point of fact caused me to desire every inmate of my family to give me immediate notice of the appearance of anything unusual in the heavens, and thus led directly to the observations above detailed.

A paper was also in part read, entitled, "Researches into the Structure and Developement of a newly discovered parasitic Animalcule of the Human Skin, the *Entozoon folliculorum*." By Erasmus Wilson, Esq.: communicated by R. B. Todd, M.D., F.R.S.

PROCEEDINGS

OF

THE ROYAL SOCIETY.

1843. No. 57.

March 30, 1843.

GEORGE RENNIE, Esq., V.P., in the Chair.

Joseph Miller, Esq. was balloted for and duly elected a Fellow of the Society.

The following papers were read, viz.—

1. " Researches into the Structure and Developement of a newly discovered parasitic Animalcule of the Human Skin, the *Entozoon folliculorum*." By Erasmus Wilson, Esq., Lecturer on Anatomy and Physiology at the Middlesex Hospital. Communicated by R. B. Todd, M.D., F.R.S.

While engaged in researches on the minute anatomy of the skin and its subsidiary organs, and particularly on the microscopical composition of the sebaceous substance, the author learned that Dr. Gustow Simon of Berlin had discovered an animalcule which inhabits the hair follicles of the human integument, and of which a description was published in a memoir contained in the first Number of Müller's Archiv for 1842. Of this memoir the author gives a translation at full length. He then states that, after careful search, he at length succeeded in finding the parasitic animals in question, and proceeded to investigate more fully and minutely than Dr. Simon had done the details of their structure, and the circumstances of their origin and developement. They exist in the sebaceous follicles of almost every individual, but are found more especially in those persons who possess a torpid skin; they increase in number during sickness, so as in general to be met with in great abundance after death. In living and healthy persons, from one to three or four of these entozoa are contained in each follicle. They are more numerous in the follicles situated in the depression by the side of the nose; but they are also found in those of the breast and abdomen, and on the back and loins. Their form changes in the progress of their growth. The perfect animal presents an elongated body, divisible into a head, thorax, and abdomen. From the front of the head proceed two moveable arms, apparently formed for prehension: and to the under side of the thorax are attached four pairs of legs, termi-

nated by claws. The author distinguishes two principal varieties of the adult animal; the one remarkable for the great length of the abdomen and roundness of the caudal extremity; whilst the other is characterized by greater compactness of form, a shorter abdomen, and more pointed tail. The first variety was found to measure, in length, from the one-100th to the 45th, and the second, from the one-160th to the 109th part of an inch.

The author gives a minute description of the ova of these entozoa, which he follows in the successive stages of their developement. The paper is accompanied by numerous drawings of the objects described.

2. "On Factorial Expressions, and the Summation of Algebraic Series." By W. Tate, Esq. Communicated by the Rev. Henry Moseley, M.A., F.R.S., &c.

This paper, which is wholly analytical, contains an investigation of certain general methods for the summation of algebraic series, which have led the author to the discovery of some curious and elegant propositions relative to factorials and the decomposition of fractions; and also to a new demonstration of Taylor's theorem.

3. "Notice of the Comet;" in a Letter from Captain John Grover, F.R.S., addressed to P. M. Roget, M.D., Sec. R.S., and dated from Pisa, March 21st, 1843.

The author states that at Pisa, on Friday, the 17th of March, 1843, at eight o'clock in the evening, he saw a luminous arc in the heavens, extending from a spot about a degree to the south of Rigel to some clouds which bounded the western horizon. It was about 40 minutes in width; the edges sharply and clearly defined. On the 20th of March, the author could distinctly trace the extremity of the luminous streak, which he concluded was the tail of a comet, below the lower part of the constellation Orion, and reaching to the star η Eridani; while the stars δ and ϵ Eridani were distinctly seen with the naked eye through the coma. From η Eridani, it extended 47° 30′ to a spot nearly equidistant from χ Orionis and η Leporis.

4. "Variation de la Déclinaison et Intensité Horizontales Magnétiques observées à Milan pendant vingt-quatre heures consécutives le 18 et 19 Janvier, et le 20 et 25 Fevrier 1843." Par C. Carlini, For. Mem. R.S.

5. A paper was also in part read, entitled "On the general and minute Structure of the Spleen in Man and other Animals." By William Julian Evans, M.D. Communicated by P. M. Roget, M.D., Sec. R.S.

April 6, 1843.

FRANCIS BAILY, Esq., V.P., in the Chair.

Henry Wollaston Blake, Esq., and James Heygate, M.D., were balloted for and duly elected Fellows of the Society.

The following papers were read, viz.—

1. "On the general and minute Structure of the Spleen in Man and other Animals." By William Julian Evans, M.D. Communicated by P. M. Roget, M.D., Sec. R.S.

After adverting briefly to the discordant opinions of Malpighi, Ruysch, and others regarding the structure of the spleen, the author proceeds to detail the results of the investigations on this subject, in which he has been for many years engaged. According to his analysis, the following are the component parts of this organ:—first, a reticulated fibro-elastic tissue; secondly, a pulpy parenchyma, containing the Malpighian glands and the splenic corpuscles; thirdly, distinct cellular bodies; fourthly, the usual apparatus of arteries, veins, lymphatics and nerves; fifthly, certain fluids; and lastly, the membranes or tunics by which it is invested.

He describes the cells of the spleen as being formed of a lining membrane, continued from that of the splenic vein, and strengthened by filaments of the fibro-elastic tissue. The splenic vein communicates with these cells, at first by round foramina, then by extensive slits resembling lacerations; and it ultimately loses itself entirely in the cells. The cells themselves communicate freely with one another, and also with the veins of the parenchyma; and may therefore be considered as in some measure continuations of the veins. This structure constitutes a multilocular reservoir of great extensibility, and possessing great elastic contractility; properties, however, which exist in a much less degree in the human spleen than in that of herbivorous animals; in which animals the cellated structure itself is much more conspicuous, and predominates over the parenchymatous portion. As the splenic artery has no immediate communication with the cells, these latter may be filled much more readily by injection from the vein than from the artery. In the ordinary state of the circulation, the blood, which has passed into the cells from the veins, is pressed into the branches of the splenic veins by a force derived from the elasticity of the fibro-elastic tissue which surrounds the cavities of the cells, thus constituting a *vis-a-tergo*, which contributes to propel the blood onwards in its circulation through the liver. Should there arise, however, any obstructing cause which the resilience of the spleen is unable to overcome, a regurgitation must take place, leading to a congestion both in the mesenteric and splenic veins. The spleen may thus serve as a receptacle for the blood of the abdominal circulation during any temporary check to its free passage into the vena cava; a purpose which is more fully answered in herbivorous animals in whom the abdominal circulation is more

extensive, and the spleen is of larger dimensions and greater elasticity.

The splenic corpuscles are thickly scattered throughout the cellular parenchyma of this organ; and from each corpuscle there arises a minute lymphatic vessel; the interlacing of adjacent lymphatics giving rise to a fine and extensive net-work. The trunks of these vessels enter into the Malpighian glands, and again ramifying, form a lymphatic plexus in the interior of these bodies. The fluid contents of these vessels, which had been before pellucid, is now found to contain white organic globules, similar in every respect to those observed in the fluid of lymphatic glands in other parts of the body. The author considers the secretion of this fluid, which appears to be identical with the contents of the lymphatic glands, as being the peculiar function of the splenic parenchyma.

A few illustrative drawings and diagrams accompany this paper.

2. "On the Structure and Developement of the Nervous and Circulatory Systems, and on the existence of a complete Circulation of the Blood in Vessels in the Myriapoda and the Macrourous Arachnida." By George Newport, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

This paper is the first of a series which the author proposes to submit to the Royal Society on the comparative anatomy and the developement of the nervous and circulatory systems in articulated animals. Its purpose is, in the first place, to investigate the minute anatomy of the nervous system in the Myriapoda and the Macrourous Arachnida, and more especially with reference to the structure of the nervous cord and its ganglia; and thence to deduce certain conclusions with respect to the physiology of that system and the reflex movements in vertebrated animals; secondly, to demonstrate the existence of a complete system of circulatory vessels in the Myriapoda and Arachnida; and thirdly, to point out the identity of the laws which regulate the developement of the nervous and circulatory systems throughout the whole of the Articulata, and the dependence of these systems on the changes which take place in the muscular and tegumentary structures of the body, as, in a former paper, he showed was the case with regard to the changes occurring in the nervous system of true insects.

The first part of the paper relates to the nervous system. A description is given of this system in the Chilognatha, which the author was led, by his former investigations, to regard as the lowest order of the Myriapoda, and approximating most nearly to the Annelida. He traces the different forms exhibited by the nervous system in the principal genera of that order, the most perfect of which are connected on the one hand with the Crustacea, and on the other with true insects. Passing from these to the Geophili, the lowest family of the Chilopoda, which still present the vermiform type, the nervous system is traced to the tailed Arachnida, the Scorpions, through Scolopendra, Lithobius and Scutigera; the last of which tribes connects the Myriapoda on the one hand with the

true insects, and on the other with the Arachnida. The brain and the visceral nerves, the coverings and structure of the cord and ganglia, and the distribution of the systemic nerves are examined in each genus, but more particularly in the Scorpion, in which the nerves of the limbs are traced to the last joints of the tarsi, and those of the tail to the extremity of the sting. Especial attention is bestowed on the structure of the cord and its ganglia, and their developement during the growth of the animal. In the lowest forms of the Iulidæ, in which the ganglia are very close together, and hardly distinguishable from the non-ganglionic portions of the cord, the author has satisfactorily traced four series of fibres, a superior, and an inferior one, and also a transverse and a lateral series. The superior series, which he formerly described in insects as the motor tract, he has assured himself is distinct from the inferior, which he regarded as the sensitive tract; this evidently appears on examining the upper and under sides of a ganglionic enlargement of the cord. On the upper surface the direction of the fibres is perfectly longitudinal; while the fibres on the under surface are enlarged, and curvilinear in their direction. But he remarks that it is almost impossible to determine by experiment whether these structures are separately motor and sensitive, as formerly supposed, or whether they both administer to these functions by an interchange of fibres. These two series appear also to be separated in each ganglionic enlargement of the cord by the third series, constituting the transverse or commissural fibres, which pass transversely through the ganglia, and of which the existence was first indicated by the author in his paper on the *Sphinx ligustri*, published in the Philosophical Transactions for 1834. The author states that, in addition to these, there is in each half of the cord another and more important series of fibres, which constitute a large portion of the cord, but of which the existence has hitherto entirely escaped observation. This series forms the lateral portion of each half of the cord, and differs from the superior and inferior series in the circumstance, that while those latter series are traceable along the whole length of the cord to the subœsophageal and cerebral ganglia, the former series extends only from the posterior margin of one ganglion to the anterior margin of the first or second beyond it; thus bounding the posterior side of one nerve and the anterior of another, and forming part of the cord only in the interval between the two nerves. From this circumstance, the author designates the fibres of this series, *fibres of reinforcement of the cord*. Every nerve proceeding from a ganglionic enlargement is composed of these four sets of fibres, namely, an upper and an under one, communicating with the cephalic ganglia; a transverse or commissural, which communicates only with corresponding nerves on the opposite side of the body; and a lateral set, which communicates only with nerves from another ganglionic enlargement on the same side of the body, and which forms part of the cord in the interspace between the ganglia. The author had long suspected that this latter set of fibres existed; but he had never, until lately, ascertained their presence by actual observation. Their action seems fully to account for the re-

flected movements of parts both anterior and posterior to an irritated limb; as that of the commissural set does the movements of parts situated on the opposite side of the body to that which is irritated. In the ganglia of the cord in Iulus and Polydesmus, the fibres of the inferior longitudinal series are enlarged and softened on entering the ganglion, but are again reduced to their original size on leaving it; thus appearing to illustrate the structure of ganglia in general. In the developement of the ganglia and nerves in these genera, and also in Geophilus, the same changes take place as those which were formerly described by the author as occurring in insects; namely, an aggregation of ganglia in certain portions of the cord, and shifting of the position of certain nerves, which at first exist at ganglionic portions of the cord, but afterwards become removed to a non-ganglionic portion. The nervous cord is elongated, in order that it may keep pace with the growth of the body, which is periodically acquiring additional segments: that this elongation takes place in the ganglia is proved by these changes of position in the nerves lying transversely across the ganglia. The author infers from these facts, that the ganglia are centres of growth and nourishment, as well as of reflex movements, and that they are analogous to the enlargements of the cord in the vertebrata.

A series of experiments on the Iulus and Lithobius are next related; the result of which shows that the two supra-œsophageal ganglia are exclusively the centres of volition, and may therefore strictly be regarded as performing the functions of a brain: so that when these ganglia are injured or removed, all the movements of the animal are of a reflex character. When, on the other hand, these ganglia are uninjured, the animal movements are voluntary, and there exists sensibility to pain: there is, however, no positive evidence that the power of sensation does not also reside in the other ganglia.

The second part of the paper relates to the organs of circulation. In all the Myriapoda and Arachnida the dorsal vessel or heart is divided, as in insects, into several compartments, in number corresponding to the abdominal segments. Its anterior portion is divided, immediately behind the basilar segment of the head, into three distinct trunks. The middle portion, which is the continuation of the vessel itself, passes forwards along the œsophagus, and is distributed to the head itself; while the two others, passing laterally outwards and downwards in an arched direction, form a vascular collar round the œsophagus, beneath which they unite in a single vessel, as was first noticed by Mr. Lord in the Scolopendra. This single median vessel lies above the abdominal nervous cord, and is extended backwards throughout the whole length of the body as far as the terminal ganglia of the cord, under which it is subdivided into separate branches accompanying the terminal nerves to their final distribution. Immediately anterior to each ganglion of the cord, this vessel gives off a pair of vascular trunks; and each of these trunks is divided into four arterial vessels, one of which is given to each of the principal nerves proceeding from the ganglion, and may be traced along with it to a considerable distance. Of these, the vessel situated

most posteriorly is again connected with the great median trunk by means of a minute branch, so that the four vessels on each side form, with their trunks, a complete vascular circle above each ganglionic enlargement of the cord. Besides these, which may be regarded as the great arterial trunk and vessels conveying the blood directly from the anterior distribution of the heart to the limbs and inferior surface of the body, the author has also discovered a pair of large arterial vessels in each segment, originating directly from the posterior and inferior surface of each chamber of the heart. These vessels he has named *the systemic arteries*; and in the Scolopendra he has traced them from the great chamber of the heart, which is situated in the penultimate segment of the body, to their ultimate distribution and ramification in the coats of the great hepatic vessels of the alimentary canal.

After the blood has passed from the arteries, it is returned again to the heart in each segment of the body by means of exceedingly delicate transparent vessels, which pass around the sides of the segments and communicate with the valvular openings of each chamber of the heart at its upper surface, where the valvular openings are situated, not only in all the Myriapoda, but also in the Scorpionidæ. In Scorpions, the circulatory system is more complete and important than even in the Myriapoda. The heart, divided as in Myriapods into separate chambers, is lengthened out at its posterior extremity into a long caudal artery, and gives off a pair of systemic arteries from each chamber, precisely as in the Myriapoda. These arteries not only distribute their blood to the viscera, but send their principal divisions to the muscular structures of the inferior and lateral parts of the body, as well as to the pulmonary sacs. At the anterior part of the abdomen, the heart becomes aortic, descends suddenly into the thorax, and immediately behind the brain spreads out into several pairs of large trunks, which are given to the head, and to the organs of locomotion. The posterior of these trunks form a vascular collar around the œsophagus, beneath which they unite, anteriorly, to a strong bony arch in the middle of the thorax, to form the great arterial trunk, or supra-spinal vessel, which conveys the blood to the posterior part of the body, as in the Myriapoda. This vessel passes beneath the transverse bony arch of the thorax, and is slightly attached to it by fibrous tissue, which circumstance probably induced Professor Müller, who observed this structure in 1828, to regard it as a ligament. In its course backwards, along the nervous cord, this vessel is gradually lessened in size, until it arrives at the terminal ganglion of the cord in the tail, where it is divided into two branches, which take the course of the terminal nerves, and these are again subdivided before they arrive at their ultimate distribution. In addition to these parts, the author found a hollow fibrous structure, which closely surrounds the cord and nerves immediately after they have passed beneath the arch of the thorax. From the sides of this structure there pass off backwards two pairs of vessels, that get beneath the peritoneal lining of the abdominal cavity and are distributed on the first pair of branchiæ. A small vessel also

passes backwards beneath the cava, and, being joined by anastomoses from the spinal artery, form the commencement of a vessel which the author formerly described in the 'Medical Gazette' as the *subspinal vessel*. This vessel, extending along the under surface of the nervous cord, communicates directly, by short vessels, with the supra-spinal artery, and gives off, at certain distances from its under surface, several large vessels, which unite with others that convey the blood which has circulated through the abdominal segments, directly to the branchiæ, whence it is returned to the heart by many minute vessels that originate from the posterior internal part of each branchia, and, united into single trunks, pass around the sides of the segments to the valvular openings on the dorsal surface of the heart. In the tail of the Scorpion there is a direct vascular communication between the caudal artery and the subspinal vein, which, from the direction of the vessels, induces a belief that there is some peculiarity in the circulation of the blood in this part of the body. Besides these vessels, the author found an arterial trunk that originates from the commencement of the aorta as it descends into the thorax. This vessel passes backwards along the alimentary canal, to which it is distributed, and gives off branches to the liver.

This paper is accompanied by five drawings, illustrating the anatomical facts which are described in it.

The Society then adjourned over the Easter Recess to meet again on the 27th instant.

In consequence of the lamented death of H. R. H. the Duke of Sussex, the Society did not resume their Meetings till the 11th of May.

May 11, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

George Basevi, Esq., and Colonel John Le Couteur, were balloted for, and duly elected into the Society.

Edward Speer, Esq., was also balloted for, but not elected into the Society.

The following papers were read, viz.—

1. "Variations de la Déclinaison et Intensité Horizontale magnétique observées à Milan pendant vingt-quatre heures consécutives le 22 et 23 Mars, et le 19 et 20 Avril 1843." Par F. Carlini, For. Mem. R.S.

2. "Note regarding the Observations of T. Wharton Jones, Esq., F.R.S., 'On the Blood Corpuscles.'" By Martin Barry, M.D., F.R.S. L. & E.

The author observes, that the structure of the blood-corpuscles can be accurately learned only by a careful investigation of their mode of origin, and by following them through all their changes in the capillary vessels, and especially in the capillary plexuses and dilatations, where all their stages of transition from the colourless to the red corpuscles may be seen. The filament which forms here and there in the corpuscles of coagulating blood he has shown to other persons, with Microscopes made by Ross and Powell. Dr. Barry denies that he meant certain general remarks in his paper, referring to more than twenty delineations of corpuscles from various animals, to apply exclusively to those of man.

3. A paper was also in part read, entitled, "Experiments on the Gas Voltaic Battery, with a view of ascertaining the rationale of its action, and on its application to Eudiometry." By William Robert Grove, Esq., M.A., F.R.S., &c.

The President informed the Meeting that the Council had voted the following Address of Condolence to Her Majesty the Queen, on the occasion of the demise of His Royal Highness the Duke of Sussex:—

"*To the Queen's Most Excellent Majesty.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to approach Your Majesty with the expression of our heartfelt condolence on the loss which Your Majesty has sustained by the lamented death of His Royal Highness the Duke of Sussex. In the expression of our sorrow we are sure that all Your Majesty's subjects must unite with us, when they regard the public and private virtues of His Royal Highness. We are bound to feel additional grief as a Society over which His Royal Highness had presided, and where he had uniformly shown the greatest zeal for the cause of knowledge, and the most amiable condescension and kindness to every cultivator of Physical Science."

May 18, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

James Tulloch, Esq., was balloted for, and duly elected into the Society.

1. The reading of a paper, entitled "Experiments on the Gas

Voltaic Battery, with a view of ascertaining the rationale of its Action and on its application to Eudiometry." By William Robert Grove, Esq., M.A., F.R.S., &c., was resumed and concluded.

The author, referring to a paper published in the Philosophical Magazine for December 1842, giving an account of a voltaic battery of which the active ingredients are gases, and by which the decomposition of water is effected by means of its composition, describes several variations in the form of the apparatus recorded in that paper. The experiments he has made with this new apparatus, and the details of which occupy the greater part of the present memoir, he conceives establish the conclusion that the phenomena exhibited in the gaseous battery are in strict conformity with Faraday's law of definite electrolysis. They also confirm him in the opinion which he had expressed in his original paper, and which had been controverted by Dr. Schœnbein, in a communication to the Philosophical Magazine for March 1843, as well as by other philosophers, namely, that the oxygen, in that battery, immediately contributes to the production of the voltaic current. Besides employing as the active agents oxygen and hydrogen gases, he extends his experiments to the following combinations: namely,

Oxygen and peroxide of nitrogen;
Oxygen and protoxide of nitrogen;
Oxygen and olefiant gas;
Oxygen and carbonic oxide;
Oxygen and chlorine;
Chlorine and dilute sulphuric acid;
Chlorine and solutions of bromine and iodine in alternate tubes;
Chlorine and hydrogen;
Hydrogen and carbonic oxide;
Chlorine and olefiant gas;
Oxygen and binoxide of nitrogen;
Oxygen and nitrogen, with solution of sulphate of ammonia;
Carbonic acid and carbonic oxide, with oxalic acid as an electrolyte;
Hydrogen, nitrogen, and sulphate of ammonia.

The author concludes, on reviewing the whole of this series of experiments, that, with the exception, perhaps, of olefiant gas, which appears to give rise to an extremely feeble current, chlorine and oxygen, on the one hand, and hydrogen and carbonic oxide, on the other, are the only gases which are decidedly capable of electro-synthetically combining so as to produce a voltaic current. He thinks that the vapours of bromine and of iodine, were they less soluble, would probably also be found efficient as electro-negative gases.

He proceeds to consider, in the remaining part of his paper, the application of the gas battery to the purposes of eudiometry, founded on the circumstance already mentioned, that nitrogen gas, as well as several other gases, are absolutely without effect in as far as regards any alteration of their volume, and may therefore be advantageously employed in the analysis of atmospheric air, or other

mixed gases. Several experiments of this nature are described, and others suggested for future trial. Various theoretical views, arising from this train of inquiry, are then discussed; particularly with reference to the contact theory, with which the author conceives that the action of the gas battery is not reconcileable; and also to the source of the caloric evolved during voltaic action, which he is strongly inclined to think is in the battery itself.

2. A paper was also read, entitled "Contributions to Terrestrial Magnetism." No. IV. By Lieut.-Colonel Edward Sabine, R.A., F.R.S.

In the present number of these contributions, the author resumes the consideration of Captain Sir Edward Belcher's magnetic observations, of which the first portion, namely, that of the stations on the north-west coast of America and its adjacent islands, was discussed in No. 2. The return to England of H.M.S. Sulphur by the route of the Pacific Ocean, and her detention for some months in the China Seas, have enabled Sir Edward Belcher to add magnetic determinations at thirty-two stations to those at the twenty-nine stations previously recorded.

The author first describes the experiments which he instituted with the different needles employed by Captain Sir Edward Belcher for determining the coefficient to be employed in the formula for the temperature corrections; and takes this opportunity of noticing the singular fact that, in needles made of a particular species of Russian steel, this coefficient is negative; that is, in these needles, an increase of temperature increases the magnetic power. M. Adolphe Erman describes this particular kind of steel as consisting of alternate very thin layers of soft iron and of steel, so that when heated the soft iron layers increase their magnetic intensity and the steel layers diminish theirs.

He next considers the more important question of the steadiness with which the needles may have maintained their magnetic condition. By intercomparison of the results obtained at various stations with the different needles employed, he assigns corrections to be applied to the determination of the magnetic force deduced from the observed times of vibration. The magnetic force thus corrected, from the observations with each of the needles employed at the various stations visited by Sir Edward Belcher, is then given in a general table of results. The observations of the inclination of the needle are given in another table; and a third table contains the determination of the declination and inclination of the needle, the horizontal and total magnetic intensity deduced from the observations at thirty-two stations, of which the latitudes and longitudes are given in the same table, together with the dates of observation,

May 25, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

James Moncrieff Arnott, Esq., and Samuel Elliott Hoskins, M.D., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Meteorological Journal, from January to April inclusive, 1843, kept at Guernsey." By Samuel Elliott Hoskins, M.D. Communicated by Samuel Hunter Christie, Esq., Sec. R.S.

2. "On the Respiration of the Leaves of Plants." By William Haseldine Pepys, Esq., F.R.S.

The author gives an account of a series of experiments on the products of the respiration of plants, and more particularly of the leaves; selecting, with this view, specimens of plants which had been previously habituated to respire constantly under an inclosure of glass; and employing, for that purpose, the apparatus which he had formerly used in experimenting on the combustion of the diamond, and consisting of two mercurial gasometers, with the addition of two hemispheres of glass closely joined together at their bases, so as to form an air-tight globular receptacle for the plant subjected to experiment.

The general conclusions he deduces from his numerous experiments conducted during several years, are, first, that in leaves which are in a state of vigorous health, vegetation is always operating to restore the surrounding atmospheric air to its natural condition, by the absorption of carbonic acid and the disengagement of oxygenous gas: that this action is promoted by the influence of light, but that it continues to be exerted, although more slowly, even in the dark. Secondly, that carbonic acid is never disengaged during the healthy condition of the leaf. Thirdly, that the fluid so abundantly exhaled by plants in their vegetation is pure water, and contains no trace of carbonic acid. Fourthly, that the first portions of carbonic acid gas contained in an artificial atmosphere, are taken up with more avidity by plants than the remaining portions; as if their appetite for that pabulum had diminished by satiety.

3. A paper was also in part read, entitled "On the minute Structure of the Skeletons or hard parts of the Invertebrata." Part II. By William B. Carpenter, M.D. Communicated by the President.

June 1, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Sir John P. Boileau, Bart., and the Rev. John Wright, M.A., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "Magnetic-term Observations for January, February, March, and April 1843," made at the Observatory at Prague, by Professor Kreil. Communicated by Samuel Hunter Christie, Esq., Sec. R.S.

2. "Hourly Meteorological Observations, taken between the hours of 6 A.M. March 17th, 1843, and 6 A.M. of the following day, being the period of the Spring Tides of the Vernal Equinox, at Georgetown, British Guiana." By Daniell Blair, Esq., the Colonial Surgeon, transmitted by Henry Light, Esq. Communicated by the Lords Commissioners of the Admiralty.

3. "On the minute structure of the Skeletons, or hard parts of Invertebrata." By W. B. Carpenter, M.D. Communicated by the President. Part II. "On the structure of the Shell in the several families and genera of Mollusca."

The author here gives in detail the results of his inquiries into the combinations of the component elements of shell as they are met with in the several families and genera of the Mollusca; and considers all these results as tending to establish the general proposition, that where a recognizable diversity presents itself in the elementary structure of the shell, in different groups, that diversity affords characters which indicate the natural affinities of the several genera included in those groups, and which may therefore be employed with advantage in classification, and in the recognition and determination of fossils.

The Society then adjourned over the Whitsun Recess, to meet again on the 15th instant.

June 15, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The following papers were read, viz.—

1. "On the supposed developement of the Animal Tissues from Cells." By James Stark, M.D., F.R.S.E. Communicated by James F. W. Johnston, Esq., M.A., F.R.S.

The author controverts the prevailing theory of the developement of animal tissues from cells, and denies the accuracy of the microscopical observations on which that theory is founded, as regards the anatomy of the adult as well as of the fœtal tissues. He asserts that at no period of fœtal life can rows of cells be discovered in the act of transformation into muscular fibres: and he denies that these fibres increase either in length or in thickness by the deposition of new cells. He contends that the ultimate filaments of muscles, as well as all the other tissues of the body, are formed from the fibrinous portion of the blood, which is itself composed of globules that are disposed to cohere together, either in a linear series, so as to form a net-work of fine filaments, or in aggregated masses of a form

more or less globular, composing what have been termed fibrinous corpuscles. These corpuscles have been considered to be the nuclei of cells; but the author regards them as being merely accidental fragments of broken down tissues, adhering to the filaments, and noways concerned in their developement. The more regularly disposed granules, which are observed to occupy the spaces intervening between the filaments composing the ordinary cellular tissue, he considers as being fatty matter deposited within these spaces. He, in like manner, regards the observations tending to show the cellular origin of the fibrous, cartilaginous, and osseous tissues, as altogether fallacious; and maintains that the cells, which these animal textures exhibit when viewed under the microscope, are simply spaces occurring in the more solid substance of these structures, like the cavities which exist in bread. These views are pursued by the author in discussing the formation of the skin, the blood-vessels, and the nerves, and in controverting the theory of secretion, founded on the action of the interior surfaces of the membranes constituting cells.

2. " Contributions to Terrestrial Magnetism."—No. V. By Lieut.-Colonel Edward Sabine, R.A., F.R.S.

In this paper the author details and discusses the magnetic observations made on board Her Majesty's ships Erebus and Terror, between October 1840 and April 1841, being the first summer which the expedition under the command of Captain James Clark Ross, R.N., passed within the Antarctic Circle.

The elimination of the influence of the ship's iron in the calculation of the results of these observations occupies a considerable portion of the paper. Formulæ for this purpose are derived from M. Poisson's fundamental equations, and the constants in the formulæ are computed for each of the two ships, from observations made on board expressly with that object. With these constants, tables of double entry are formed for each of the three magnetic elements, namely, declination, inclination, and intensity, giving the required corrections of each, for all the localities of the voyage.

These and other corrections being applied, the results are tabulated and charts formed from them. The full consideration of the charts is postponed until the whole of the materials collected by the Antarctic Expedition shall be before the Royal Society. Meanwhile the paper concludes with the following general remarks, viz.

1. The observations of declination, particularly those which point out the course of the lines of 0 and of 10° east, indicate a more westerly position than the one assigned by M. Gauss in the 'Atlas des Erdmagnetismus,' for the spot in which all the lines of declination unite. The progression of the lines in the southern hemisphere generally, from secular change, is from east to west; the difference consequently is in the direction in which a change should be found in comparing earlier with more recent determinations.

2. The general form of the curves of higher inclination in the southern hemisphere is much more analogous to that in the northern than appears in M. Gauss's maps. For example, the isoclinal line

of — 85°, instead of being nearly circular, as represented in the 3[te] Abtheilung of Plate XVI. of the 'Atlas des Erdmagnetismus,' is an elongated ellipse, much more nearly resembling in form and dimensions the ellipse of 85° of inclination in the northern hemisphere in the same work, Plate XVI. 2[te] Abtheilung. The analogy between the two hemispheres in the characteristic feature of the elliptical form of the higher isoclinal lines is the more important to notice, on account of the particular relation which appears to subsist in the northern hemisphere between the change in the geographical direction of the greater axis of the ellipse, and the secular changes of the inclination generally throughout the hemisphere. The present direction of the greater axis in the northern hemisphere, is nearly N.N.W. and S.S.E., or that of a great circle passing through the two foci of maximum intensity. In the southern hemisphere, the present direction of the greater axis differs little from E.S.E. and W.N.W.

3. Captain Ross's observations of the intensity do not appear to indicate the existence anywhere in the southern hemisphere of a higher intensity than would be expressed by 2·1 of the arbitrary scale. In this respect also the analogy between the two hemispheres appears to be closer than is shown in M. Gauss's maps, Plate XVIII. With respect to the direction of as much of the line of highest intensity (2·0) as it has been possible to draw with any degree of confidence from the observations now communicated, it will be found to be in almost exact parallelism with the isodynamic line of 1·7 in Plate III. of the author's report "On the Variations of the Magnetic Intensity," in the Report of the eighth meeting of the British Association, for 1838; which line was the highest of which the position could be assigned at that period for any considerable distance by the aid of the then existing determinations.

3. "An Account of several new Instruments and Processes for determining the Constants of a Voltaic Circuit," by Charles Wheatstone, V.P.R.S., Professor of Experimental Philosophy in King's College, London, Corresponding Member of the Royal Academy of Sciences at Paris, &c.

The author proposes in the present communication to give an account of various instruments and processes which he has employed during several years past for the purpose of investigating the laws of electric currents. He states that the practical object for which these instruments were originally constructed, was to ascertain the most advantageous conditions for the production of electric effects through circuits of great extent, in order to determine the practicability of communicating signals by means of electric currents to more considerable distances than had hitherto been attempted. Their use, however, is not limited to this special object, but extends equally to all inquiries relating to the laws of electric currents and to every practical application of this wonderful agent.

As the instruments and processes described by the author are all founded on Ohm's theory of the voltaic circuit, he commences with

a short account of the principal results to which this theory leads, and shows how the clear ideas of electromotive forces and resistances, substituted for the vague notions of intensity and quantity which formerly prevailed, furnish us with satisfactory explanations of phenomena, the laws of which have hitherto been involved in obscurity and doubt. According to Ohm's system, the force of the current is equal to the sum of the electromotive forces divided by the sum of the resistances in the circuit. The several electromotive forces and resistances which enter into the circuit of a voltaic battery are then defined; and having frequent occasion to refer to the laws of the distribution of the electric current in the various parts of a circuit, when a branch conductor is placed so as to divert a portion of the current from a limited extent of that circuit, the author directs particular attention to these laws. After recommending several new terms in order to express general propositions, without circumlocution and with greater precision, the author states the method of obtaining the constants of a circuit employed by Fechner, Lenz, Pouillet, &c., and then proceeds to explain the new method he has himself adopted. The principle of this method is the employment of variable instead of constant resistances, bringing, thereby, the currents in the circuits compared to equality, and inferring from the amount of the resistance measured out between two deviations of the needle, the electromotive forces and resistances of the circuit according to the particular conditions of the experiment; a method which requires no knowledge of the forces corresponding to different deviations of the needle. To apply this principle, it is requisite to have a means of varying the interposed resistance, so that it may be gradually changed within any required limits. The author describes two instruments for effecting this purpose; one intended for circuits in which the resistance is considerable, the other for circuits in which it is small. The *Rheostat* (for thus the inventor names the instrument under both its forms) may also be usefully employed as a regulator of a voltaic current, in order to maintain for any required length of time precisely the same degree of force, or to change it in any required proportion; its advantages in regulating electro-magnetic engines and in the operations of voltatyping, electro-gilding, &c. are pointed out.

Various methods of measuring the separate resistances in the circuit, particularly that of the rheomoter itself, are next described; and it is shown that the number of turns of the rheostat requisite to reduce the needle of a galvanometer from one given degree to another, is an accurate measure of the electromotive force of the circuit. It is then proved that similar voltaic elements of various magnitudes, conformably to theory, have the same electromotive force; that the electromotive force increases exactly in the same proportion as the number of similar elements arranged in series; and that when an apparatus for decomposing water is placed in a circuit, an electromotive force, opposed to that of the battery, is called into action, which is constant in its amount, whatever may be the number of elements of which the battery consists. The electromotive forces

of voltaic elements formed of an amalgam of potassium with zinc, copper and platina, a solution of a salt of the negative metal being the interposed liquid, are given; the last combination is one of great electromotive energy, and when a voltameter is interposed in the circuit, it decomposes abundantly the water contained in it. A still more energetic electromotive force is exhibited by a voltaic element, consisting of amalgam of potassium, sulphuric acid, and peroxide of lead. The author then shows, that if three metals be taken in their electromotive order, the electromotive force of a voltaic combination formed of the two extreme metals is equal to the sum of the electromotive forces of the two elements formed of the adjacent metals.

Among the instruments and processes described in the subsequent part of the memoir are the following. 1. An instrument for measuring the resistance of liquids, by which the errors in all previous experiments are eliminated, particularly those resulting from neglecting the contrary electromotive force arising from the decomposition of the liquid. 2. The differential resistance measurer, by means of which the resistances of bodies may be measured in the most accurate manner, however the current employed may vary in its energy. 3. An instrument for ascertaining readily what degree of the galvanometric scale corresponds to half the intensity indicated by any other given degree. 4. A means of employing the same delicate galvanometer to measure currents of every degree of energy, and in all kinds of circuits. 5. Processes to determine the deviations of the needle of a galvanometer corresponding to the degrees of force, and the converse.

4. "On the Organ of Hearing in Crustacea." By Arthur Farre, M.D., F.R.S.

The author finds that in the Lobster (*Astacus marinus*), the organ of hearing consists of a transparent and delicate vestibular sac, which is contained in the base, or first joint of the small antennæ; its situation being indicated externally by a slight dilatation of the joint at this part, and also by the presence of a membrane covering an oval aperture, which is the fenestra ovalis. The inner surface of the sac gives origin to a number of hollow processes, which are covered with minute hairs and filled with granular matter, apparently nervous. A delicate plexus of nerves, formed by the acoustic nerve, which is a separate branch supplied from the supra-œsophageal ganglion, is distributed over the base of these processes and around the sac. Within the sac there are always found a number of particles of siliceous sand, which are admitted, together with a portion of the surrounding water, through a valvular orifice at the mouth of the sac, being there placed apparently for the express purpose of regulating the size of the grains. The author considers these siliceous particles as performing the office of otolites, in the same way as the stones taken into the stomachs of granivorous birds supply the office of gastric teeth. Several modifications of this structure exhibited in the organs of hearing of the *Astacus fluviatilis*, *Pagurus streb-*

lonyx, and *Palinurus quadricornis* are next described, and an explanation attempted of the uses of the several parts and their subserviency to the purposes of that sense.

The author concludes by a description of another organ situated at the base of the large antennæ, which it appears has been confounded with the former by some anatomists, but which the author conjectures may possibly constitute an organ of smell. The paper is accompanied by illustrative drawings.

5. "A statement of Experiments showing that Carbon and Nitrogen are compound bodies, and are made by Plants during their growth." By Robert Rigg, Esq., F.R.S.

The author, finding that sprigs of succulent plants, such as mint, placed in a bottle containing perfectly pure water, and having no communication with the atmosphere except through the medium of water, or mercury and water, in a few weeks grow to more than double their size, with a proportionate increase of weight of all the chemical elements which enter into their composition, is thence disposed to infer that all plants make carbon and nitrogen; and that the quantity made by any plant varies with the circumstances in which it is placed.

6. "Physiological inferences derived from Human and Comparative Anatomy respecting the Origins of the Nerves, the Cerebellum, and the Striated Bodies." By Joseph Swan, Esq. Communicated by Richard Owen, Esq., F.R.S.

The author remarks that those parts of the nervous system which are concerned in motion and in sensation exhibit a great similarity in all vertebrate animals. To the first of these functions belong the anterior and middle portions of the spinal cord and medulla oblongata, including the anterior pyramids, the crura cerebri, and some fibres leading to the corpora striata and the convolutions, and also the cerebellum. To the function of sensation belong the posterior surface of the spinal cord, the posterior and lateral portions of the medulla oblongata, including the posterior pyramids, the ventricular cords, and the fourth and third ventricles.

From a general comparison of the relative magnitude and structure of these several parts in the different classes of vertebrated animals, the author infers that only a very small portion of the brain is necessary for the origins of the nerves, their respective faculties being generally derived near the place at which they leave the brain. These origins are traced in various cases, where, from peculiarities of arrangement or of destination, they present certain remarkable differences of situation.

The author is led to consider the cerebellum as an appendage to the brain, rather than to the medulla oblongata and spinal nerves, for it does not correspond with either the number or the size of the sensitive or motor nerves; and that it is not required for the intellect, for the special senses, for common sensation, or for volition, appears from its size bearing no proportion to the strength of

any of these faculties. Neither is it concerned in digestion or assimilation, nor does its size present any relation with the heart, the lungs, the muscles, the limbs, the vertebræ, the ribs, or any other organ, not even those of reproduction. As, however, its nervous connexions are principally with those parts which are exclusively subservient to the will, it is probable that it is concerned in the completion, and not in the commencement of the voluntary act. It is probable, also, that the principal crossing of impulses from one side to the other takes place in the medulla oblongata and the motor tracts of the brain. Some of the arrangements of its lobules may have reference to the paces and attitudes of different animals. The will, acting through the cerebral convolutions, sets in action certain muscles placed in proper directions; but the influence of the cerebellum is required for giving them steadiness amidst the alternations from one set to another, and especially when a slight change disturbs the centre of gravity, and until the balance is effectually restored by a subsequent act of the will operating on antagonist or other muscles. The cerebellum also constitutes an additional focus of nervous influence, and may, therefore, cooperate with the brain in increasing the vital powers, and imparting greater energy to the various functions of the body.

The author regards the corpus striatum as being a centre for conveying to the mind the perception of the motions of the limbs and of their different parts. He concludes with some remarks on the double crossings of the tracts of the centres of the nerves of the arms and legs, and the explanation given by these facts to various pathological phenomena.

7. "Nouveaux faits à ajouter à la Théorie de la Chaleur et à celle de l'Évaporation." Par Daniel Parat, Médecin à Grenoble. Communicated by the President.

The author commences by explaining his conception of the nature of heat, of which he gives the following definition:—"Mouvemens centraux obsculaires de la cohésion devenus extemporanément plus rapides, et dilatant de plus en plus tous les corps par une augmentation ainsi acquise de toutes les forces centrifuges." He adopts the theory that the evaporation of water in contact with air is a process identical with chemical solution, and adduces as evidence supporting his views various circumstances which are common both to evaporation and to the solution of a salt in water.

8. "On the nature and properties of Iodide of Potassium, and its general applicability to the cure of Chronic Diseases." By James Heygate, M.D., F.R.S.

The author has been led by his experience to estimate highly the medicinal properties of the iodide of potassium (which he prefers to the tincture of iodine) in various diseases, and thinks that when it is administered judiciously no deleterious effects are likely to arise from its use.

9. "Observations on the relation which exists between the Re-

spiratory Organs of Animals, and the preservation of independent Temperatures." By George Macilwain, Esq., Consulting Surgeon to the Finsbury Dispensary. Communicated by William Lawrence, Esq., F.R.S.

The author expresses his dissent from the prevailing opinion that the temperature maintained by animals above the surrounding medium is proportionate to the extent of their respiration; and adduces many instances among different classes of animals in which he can trace no such correspondence, and others, on the contrary, where increased powers of respiration appear to diminish instead of raising the animal temperature. Hence the author is disposed to regard respiration as a refrigerating rather than a heating process.

The Society then adjourned over the long vacation, to meet again on the 16th of November next.

INDEX TO VOL. IV.

END OF THE FOURTH VOLUME.

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RED LION COURT, FLEET STREET.

Address to Her Majesty referred to in the Address of H. R. H. the President of the Royal Society.

" *To the Queen's Most Excellent Majesty.*

" The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

" May it please Your Majesty,

" We Your Majesty's most dutiful and loyal subjects, the President and Council of the Royal Society of London for improving Natural Knowledge, beg leave most humbly to offer to Your Majesty, in the name of the Society, our most sincere condolence on the death of our late Sovereign, King William the Fourth, our most gracious Patron, whose enlightened zeal for the improvement and maintenance of the institutions of this country, and whose munificent support of the Royal Society, we shall ever remember with respect and gratitude.

" At the same time that we venture to express to you, Madam, the deep sense which we entertain of the great loss sustained by Your Majesty and by the nation at large in the demise of the late King, we beg leave to offer, with all loyalty and sincerity, our congratulations on the accession of Your Majesty to the throne of this great empire. The careful instruction in the duties and responsibilities of your high station which Your Majesty has received from your illustrious mother, aided by those happy dispositions which have been manifested by Your Majesty from your earliest years, encourages us to hope, in common with the rest of your loyal subjects, that Your Majesty's reign may form a happy and a glorious epoch in the annals of our country; that it may be distinguished by the triumphs of the arts of peace, and the general diffusion and advancement of religion and knowledge; and we fervently pray that the gentleness and purity of Your Majesty's sex and character may exercise a tranquillizing influence upon the violence of all party feelings, and tend to unite all classes of Your Majesty's subjects in common efforts to promote the happiness and prosperity of their common country.

" The Royal Society of London has enjoyed from the period of its foundation the uninterrupted patronage of Your Majesty's royal predecessors, and we are accustomed to refer with just and becoming pride to the succession of their signatures which appear in our Register, declaring themselves the patrons of our Society and the friends and protectors of its labours. We feel encouraged by their example, most gracious Lady, to solicit from Your Majesty the same protection and support which we have received from other members of Your Majesty's Royal House; and we most humbly and respectfully request that Your Majesty would be graciously pleased to inscribe your royal name in our Register as Patroness of our Society, so that it may continue to boast, as it has hitherto done, that 'Kings have been its nursing fathers and Queens its nursing mothers.'

"But whilst we gratefully express our sense of the general support and protection which the Royal Society has received from Your Majesty's royal predecessors, we feel called upon to declare our more especial obligations to their Majesties King George IV. and King William IV. of blessed memory, who graciously placed at our disposal two gold medals to be given annually in such a manner as was considered best calculated to promote the general interests of science. We trust, most illustrious Princess, that in the disposal of those Royal Medals the President and Council have endeavoured to fulfil the patriotic views and expectations of their enlightened and royal founders; and we venture most humbly and respectfully to express our hope that Your Majesty will be pleased to continue to us the same gracious patronage and generous protection which was afforded to us by Your Majesty's royal uncles and predecessors.

"That Your Majesty may enjoy length of days and every earthly happiness, and that Your Majesty may continue with increase of years to be more and more endeared to the affections of a free and grateful people, is the earnest wish and prayer of Your Majesty's loyal and devoted subjects, the President, Council, and Fellows of the Royal Society of London."

Whitehall, November 24, 1837.

"SIR,—I have the honour to acknowledge the receipt of Your Royal Highness's letter of the 18th instant, transmitting an Address of the President, Council, and Fellows of the Royal Society of London, and requesting that it may be laid before Her Majesty.

"I have the honour to inform Your Royal Highness, that I have laid before the Queen this Address, which Her Majesty was pleased to receive very graciously.

"I am commanded by the Queen to inform Your Royal Highness, that Her Majesty is sensible of the loyalty and attachment expressed in the Address, and that the wish of the Royal Society, that Her reign may be distinguished by the triumphs of the Arts of Peace, and by the general diffusion and advancement of religion and knowledge, is highly acceptable to Her Majesty.

"I am further commanded to assure Your Royal Highness, that Her Majesty will have great satisfaction in becoming Patroness of the Royal Society, of which Your Royal Highness is President.

"Her Majesty is also graciously pleased so accede to the request of the Royal Society, by placing at their disposal, annually, two Gold Medals, and promises to the Royal Society the same patronage and protection which has been afforded to them by her predecessors.

"I am, Sir,
"Your Royal Highness's
"Very dutiful and faithful servant,
"J. RUSSELL."

"His Royal Highness
the Duke of Sussex, K.G. &c. &c. &c."

DEFENCE

OF THE

RESOLUTION FOR OMITTING

MR. PANIZZI'S BIBLIOGRAPHICAL NOTES

FROM THE

CATALOGUE OF THE ROYAL SOCIETY.

Mr. Panizzi's Letter to His Royal Highness the Duke of Sussex, relative to the new Catalogue of the Royal Society, has been so ably answered by the Council, that it would be superfluous to enter into the general topics which it embraces; but as there is one part of it which may yet lead to an erroneous impression, a few additional remarks upon the subject seem still to be requisite.

When Mr. Panizzi, with the assistance of Mr. Roberton, had collected the titles of the books in the library of the Royal Society, he had overcome the most laborious part of his task; and there can be little doubt, that, if he would have satisfied himself with the careful arrangement of these materials, he would have laid the foundation of an useful catalogue. But there is a doubt (and a very considerable one) as to the value and accuracy of the notes and remarks, which, from his anxiety to distinguish this Catalogue, Mr. Panizzi was induced, occasionally, to add to the articles which it contained. In support of this opinion, the following remarks are, therefore, submitted to the Fellows of the Royal Society, by a *Member of the Catalogue-Committee*; who thinks it due to those with whom he has been appointed to act, that the real state of the case should be properly explained.

Mr. Panizzi is evidently hurt that this part of his labours, on which he seems greatly to pride himself, has not been so highly

estimated as he expected. Now there is no wish to give unnecessary pain; but as he has challenged the inquiry, he has left no choice but the admission of his claim, or a justification of the committee; which latter alternative unfortunately cannot be realised but at his expense. The justification, however, need not extend to any great length: for Mr. Panizzi has at page 31 of his Letter collected for himself certain instances which he considers to be characteristic of his work; and as it is scarcely to be conceived that he should be so completely wanting to his own reputation, as not to have selected those which make most for the strength of his cause, he must admit that every advantage is given him, when issue is joined on these very points, and the discussion confined to them alone.

Mr. Panizzi rests upon the four following instances of the value and importance of his bibliographical notes: each of these cases will therefore be examined in the order in which he has arranged them.

1st. He says:—

> To the entry 'Elémens de Géometrie,' said to be by Louis Duke of Bourgogne, printed at Paris in 1729, 8°. I added the following note: 'This work is generally supposed to be by Malezieu, mathematical teacher to the Duke, who wrote out the lessons which he received. The publishers, in the dedication, allude to the fact that Malezieu possessed a copy of the book in the hand-writing of the Duke of Bourgogne.'

The connection of Malezieu with this work affords a curious anecdote, but if introduced in this place, it ought to have been stated with more precision. The allusion, in the dedication, to the manuscript copy—valeat quantum valere potest—certainly favours the title of the Duke to the authorship, and therefore might have suggested the propriety of further inquiry on this head, for the satisfaction of the reader, if not for the purpose of ascertaining the truth. The *Biographie Universelle*, in the life of Malezieu, assigns the work unconditionally to him; but with what exactness, may be seen from the original statement of Fontenelle in his Eloge of that academician. It is there said "Parmi tous les Elémens de Géometrie, qui avoient paru jusque-là, il choisit ceux de M. Arnaud, comme les plus clairs, & les mieux digérés, pour en faire le fond des leçons qu'il donneroit à M. le Duc de Bourgogne. Seulement il fit à cet ouvrage quelques additions et quelques retranchemens. Il remarqua bientôt que le jeune Prince, qui surmontoit avec une extreme vivacité les difficultés d'une étude si épineuse, tomboit

" aussi quelquefois dans l'inconvénient de vouloir passer à coté, " quand il ne les emportait pas d'abord. Pour le fixer davantage, " il lui proposa d'écrire de sa main, au commencement d'une leçon, " ce qui lui avoit été enseigné la veille. Toutes ces leçons écrites " par le Prince pendant le cours de quatre ans, et précieusement " rassemblées, ont fait un corps, que M. Boissière, bibliothécaire " de M. le Duc du Maine, fit imprimer en 1715, sous le titre d'Elé- " mens de Géometrie de M. le Duc de Bourgogne. L'Editeur les " dédie au Prince même, qui en est l'auteur, et n'oublie pas tout ce " qui est du au scavant maitre de Géométrie. Il y a à la fin du livre " quelques problèmes, qui n'appartiennent point à des Elémens, ré- " solus par la méthode analytique, et qui, selon toutes les appa- " rences, sont de M. de Malezieu."

From this statement it is clear that there is no room for *supposition*, either general or particular, excepting for the analytical problems at the end of the volume, which are distinct from the body of the work; but, on the contrary, that the share which belongs to each individual is distinctly described. Malezieu, it appears, drew up no Elements of Geometry, but used Arnaud's as his text-book, " only " making some additions and omissions" to accommodate them better to the study of his pupil; an expression which conveys the idea of these alterations not having been extensive. The Duke had every day to analyse and draw up an account of what he had acquired on the day before. That in forming these analyses he must have been guided by what he had previously learned through the means of his tutor, is not denied; but the combinations may have been in many instances his own: and, at all events, the language which he used must have been so, or the practice, enjoined to him, could not have been effective. Fontenelle gives not the slightest intimation of any corrections introduced by Malezieu into the manuscript; and the Duke (whom he expressly speaks of as the author of the volume,) ought not, therefore, by an unqualified surmise, to be deprived of honour which is justly due to him.

2. Mr. Panizzi goes on to say:—

> To the 'Mémoires' of Charnières on the observations of the longitude, I added this note: 'All the author's additions and corrections 'carefully put in by J. B.' This note is on the title-page of this copy, and the volume is interspersed with alterations in manuscript. I suppose J. B. to mean James Bradley.

This conjecture is one, on which Mr. Panizzi seems to set considerable value, for he returns to it at the bottom of the page, and says,

"The author's additions, if put in by Bradley, are of course of much "more value than if written by any other J. B."

That Dr. Bradley was not in the habit of writing, in this manner, on his books, is a fact that could only be accidentally known to any one; and Mr. Panizzi could not be called upon to be acquainted with it. But he was called upon to have paused before he introduced such a note as this into a book, which was to go out to the world under the sanction of the Royal Society. Bradley's handwriting is very remarkable, and it will be seen immediately that Mr. Panizzi did not take the very obvious precaution of comparing it with what is written in this volume. There could have been no difficulty in doing so; for there are papers of Bradley in the British Museum; and his signature (at least) might have been readily examined at the Royal Society. Under these circumstances there was nothing to rest upon but the initials; and they might as well have belonged to Ismael Bullialdus, John Blagrave, Jacobus Bartschius, John Bainbridge, or "any other J. B." De Charnières was, indeed, an officer of the navy, in the service of Louis the Fifteenth; and to those, who might be acquainted with this fact, the impossibility of any of the particular interpretations which have been mentioned would be immediately obvious. But the *impossibility* is equally applicable to the supposition of the letters referring to James Bradley. For, the greater or less time which may elapse after the period of a man's decease, makes no difference in the objection to his having revived as a commentator; and the fact is, that Dr. Bradley died five years before the Mémoire was published by De Charnières*. But what will be said, when it is further stated, that the J. B. of the title-page has dropped his incognito at the end of this very volume; and that, if Mr. Panizzi had looked so far he would have found the insertion of the notes claimed specifically in that place by "J. Bevis," whose handwriting has not the smallest resemblance to that of James Bradley? The one is small and remarkably neat, the other is large and rather awkwardly formed. It may be further stated that there are no other alterations in the book than the "corrections and additions" pointed out by the author himself at the end of the volume.

3. Mr. Panizzi's next instance is as follows:—

> To the 'Liber novem judicum in judiciis astrorum,' I appended a note as follows: 'Panzer, v. 398, 489, gives the name Meschella and

* It is only a single Mémoire of De Charnèires, not a collection of "Mémoires" by Charnières, as Mr. Panizzi describes it.